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NEW YORK, SATURDAY, JUNE 23, 1900.

CONTENTS.

	PAGE
Editorial	927
Kinloch Long-Distance Telephone Company	930
Annual Meeting of the New York Electrical Society	930
Physics' Section, A. A. A. S.	930
Export Trade with China	930
Pan-American Congress	930
The United Electric Light & Power Company	931
Independent National Telephone Convention	934
Mutual Inductance of Three-phase Circuits, by Aug. J. Bowie, Jr.	939
A New Synchronous Device for Rotary Converters, by F. W. Springer	944
At the Paris Exposition—Palace of Mechanics	945
Current News and Notes	947
LETTERS TO THE EDITORS:	
A Coherer Telephone Transmitter, by E. B. Thornton	949
Discoloration of Wires, by L. C. Marbury	949
Digest of Current Electrical Literature, Compiled by Dr. E. F. Roeber	949
Notes of the Independent Telephone Convention, Cleveland, Ohio	955
Desk Telephone	959
Electric Storage Battery Company's Convention	959
A New Bipolar Telephone Receiver	960
The Queen-Schultze Chronoscope	960
Burr Come-Along	960
The Works of the E. W. Bliss Co.	960
Automatic Gear-Cutting Machine	961
NEWS OF THE WEEK	962

THE CLEVELAND INDEPENDENT TELEPHONE CONVENTION.

The convention last week at Cleveland of the Independent Telephone Association was, both in attendance and in enthusiasm for past achievements and future prospects, well in keeping with the cause it represented. The substantial growth of the independent movement is of such recent date that the results accomplished are little less than phenomenal. In his address, President Thomas stated that since the beginning of the Independent Telephone movement six years ago, the five hundred thousand telephones of that period had grown to two million five hundred thousand. This growth, of course, has not been entirely confined to the independent field, but it was justly remarked that it is nevertheless largely a direct result of the movement, for the reason that the Bell Company has been compelled thereby to relinquish its former policy of neglecting the smaller communities whose needs have more recently been supplied. Still another benefit is the great improvement that has followed in telephonic apparatus—and particularly in switchboards—from the competition involved. From the address of President Thomas it appears that the association has been making an effort to compile statistics relating to independent telephone exchanges, and it is to be hoped that these will soon be sufficiently complete to enable a more correct estimate to be made, than has heretofore been possible, of the number of telephone stations connected with independent exchanges. At the convention, this number was assumed to be one million, and one statement implied that it is a half-million more.

The able address of President Thomas and the paper by Mr. J. B. Ware, were easily the leading features of the convention. The former is broad in spirit and discusses in a brief though comprehensive manner the more important phases of the independent telephone situation. Naturally, considerable prominence is given to the question of long-distance toll service. It is pointed out that in order to give good service, the character of the construction must be the same throughout; the business must be handled economically and the service must be prompt—which is, after all, merely a problem similar to one which has been met and successfully solved by the railroad companies through the formation of passenger and freight associations having cognizance of the business passing over the lines of the several companies. The plan discussed by Mr. Ware is, by a not unexpected coincidence, practically that dealt with by President Thomas, and the consideration in detail which it receives in the paper shows its entire feasibility. It is true that the plan has in part already been put into execution, but the important feature of the division of toll receipts still requires careful study, the more so that it contains elements which may give rise to discord if just consideration is not given to the several conflicting factors.

WEHNELT INTERRUPTER ON ALTERNATING-CURRENT CIRCUITS.

It was at one time remarked by a well-known electrical engineer that one advantage of storage batteries was that they could not be operated on alternating-current circuits. That was before the days of converters. There has been a popular impression that the Wehnelt interrupter also enjoyed the same exclusiveness, but Mr. Hanchett's article, appearing on page 899 of our last week's issue, shows that the interrupter can be made to work on alternating-current circuits, although its behavior seems then to be characteristically different from that to which we are accustomed in connection with direct-current

circuits. When the interrupter is inserted in a direct-current circuit its frequency of interruption is determined by the inductance of the circuit and the surface density of the current at the electrode, so that as soon as the current reaches a critical density the interruption is effected. In other words, the frequency is set by the electrode in combination with the electric conditions of the circuit. When the instrument is employed on an alternating-current circuit, however, it seems that the frequency is controlled by the generator instead of by the electrode, so that the interrupter cannot be tuned by varying its electrode surface; or, at least, that the range of tuning is much more limited. This means that the instrument is not likely to be as useful in connection for exciting induction coils in alternating-current circuits as in direct-current circuits.

It is curious to consider the variety of effects which an electrolytic cell may develop. With low current densities in suitable plating solutions we obtain electro-plating with only a fraction of a volt c. e. m. f. Higher current densities in other electrolytic cells produce storage batteries with over two volts c. e. m. f., while yet higher current densities give the electric forge and the interrupter with many volts c. e. m. f. The whole range of phenomena is characterized by a marked intricacy and complexity, and the nature of the actions taking place is only gradually being unraveled.

MUTUAL INDUCTANCE OF THREE-PHASE CIRCUITS.

The paper by Mr. Bowie, appearing in this week's issue, is interesting and important. It will comfort those who are engaged in telephony, to learn that they are not the only ones who suffer from mutual inductance of circuits, and that the cross-talk between three-phase electric-light circuits, although it is monotonous in regard to rhythm, and although what the wild triphase waves are saying is always the same old song, yet it is sufficiently loud to disturb both station managers and customers. These disturbances are found under occasionally favorable circumstances in single-phase lighting circuits, but they sometimes rise to disagreeable prominence in three-phase transmission circuits. The first three-phase lines started out on the equilateral triangle system, with one wire on the pole-tops and the other wires at symmetrical distances on the same pole-arm, one on each side of the pole. This ideal condition of affairs was rudely disturbed as soon as two three-phase circuits had to be run on the same pole, since art could indeed duplicate the pole-arm, but nature insisted that there should be one, and only one, pole-top. Even if two equilateral triangles were made upon a pair of cross-arms, one triangle on each side of the pole, their mutual influences were not symmetrically distributed, and disturbance was induced. Finding that a plurality of circuits had frequently to be erected on the same poles, and that symmetry was hopeless, the engineers resigned themselves to their fate, dropped the top insulators altogether, and placed the wires in social proximity on the cross-arms like ordinary telegraph wires. This resulted in dissymmetry, which became the mother of visible electrical disturbance when the lines exceeded a certain length.

As the remedy for this objection, the spiralling of the wires was resorted to, in much the same manner as telephonists carry it out. Mr. Bowie shows that indiscriminate spiralling may not succeed in removing disturbance even with balanced loads, and that it is desirable to spiral intelligently and methodically. It is shown that if there are two circuits, one may remain without disturbance in twistless parallelism, provided that the other makes one complete twist. Also that there will be no mutual inductance if one circuit makes one twist and the other makes three. These are simple rules to remember, but what happens if the two circuits are twisted more vigorously, it is difficult to carry in mind without reference to the paper. It is a curious fact that low-tension lines are more likely to be troubled by mutual inductive disturbance than high-tension lines, considered upon the basis of equal power transmission; since the currents and magnetic effects increase as the pressure diminishes. For given current strength, however, the disturbance usually increases as the pressure on the line increases, simply for the reason that the higher the pressure the greater the distance separating individual conductors of a group, and, consequently, the greater the flux which is poured into neighboring loops. The mathematical formula expressing the mutual inductance of one conductor upon a neighboring loop is quite simple, but when we employ three conductors acting upon three neighboring loops in three-phase relationship, and these loops are varied by the geometrical conditions of spiralling, the arithmetic is likely to become complicated enough to satisfy the keenest mathematical taste.

BOOSTING ON LONG DISTANCE TRANSMISSION LINES.

In a lecture recently delivered before the English Institution of Electrical Engineers, Prof. Geo. Forbes proposed to boost the voltage at several places along the high-tension lines in order to increase the economy of transmission. This proposal has met with considerable discussion abroad. Although at first sight the argument for such an arrangement appears to be simply a new aspect of the old fallacy of transforming the power from place to place along the line, a fallacy born of telegraph repeaters, yet there is in certain extreme cases a possible saving with the proposed boosting arrangement. The idea is to raise the voltage from place to place on long lines with large drops, such as 30 or 40 per cent, in order to compensate for the resistance loss and keep the pressure between wires at or near its full initial value throughout the length of the line. A simple calculation shows that with an ohmic drop of 40 per cent the use of three boosters, dividing the line into four sections, each with a 10 per cent drop, each booster compensating for this 10 per cent drop and restoring the line pressure to the full initial value, effects a saving of about 25 per cent of the copper without reducing the efficiency, the slight loss in the boosting transformers being neglected. The reason for this saving can be readily seen by considering the definite case of a transmission line with an initial pressure of 10,000 volts and a 40 per cent drop. The pressure at the receiving station in this case would be 6000 volts and the average line pressure would be 8000. With three boosters restoring the pressure to 10,000 at one-fourth, one-half and three-fourths of the distance from the transmitting to the receiving end, the voltage received is 9000 instead of 6000, and the average line voltage is 9500 instead of 8000.

The use of a refinement of this kind presupposes a definite limiting voltage above which it is undesirable to work, but as yet the conditions of practice have not fixed such a definite limiting pressure. The difficulties of transmitting at 12,500 volts are not materially different from those at 10,000 volts, nor are those at 25,000 volts very different from those at 20,000. It is therefore preferable to reduce the necessary amount of copper 25 per cent by increasing the initial voltage on the line 10 or 15 per cent than to install boosting transformers at intermediate stations where they would be out of convenient reach in case of trouble. Assuming, however, that there were a definite limit of voltage at which a line with an extreme length and a great percentage drop must be worked in order to obtain the maximum economy of copper, there is a simple way of obtaining a uniformly distributed boosting throughout the whole length of the line by a means already generally used in this country for a totally different purpose.

In polyphase transmission to rotary converters, and particularly to rotary converters used for railway supply, where compounding or over-compounding is desirable, it is now common practice to make

use of the reactance of leading and lagging currents on line inductances to obtain at the receiving end constant voltage invariable with load variations, or to obtain voltage at the receiving end rising with increasing load, the pressure at the transmitting end remaining constant. The field strength of the rotaries is varied by the load—generally by the application of series coils—so that the phase relation of the line currents and impressed e. m. fs. changes with the load, the currents lagging behind the impressed e. m. fs. at light loads and leading them at heavy loads. By the insertion of considerable reactance in the line the impedance drop of the line is made to lag considerably behind the current so that, by means of the variation of the phase relation of the current and the impressed e. m. f., that component of the impedance drop of the line which diminishes the impressed e. m. f. can be made constant for all loads. By the use of sufficient reactance and a large angle of lead between the current and e. m. f. a boosting effect will occur in the line, the voltage being higher at the receiving end than at the transmitting end. In most cases, even with overhead transmission lines, the natural reactance of the loop between the wires is not sufficient to give the desired amount of regulation by this means without excessive variations of the power factor, so that it is customary to put in reactive coils in the low-tension supply from the step-down transformers to the rotary converters; but, even so, the line reactance forms a considerable part of the total, and is the seat of considerable of the boosting. With lines carrying large currents, it is easy to separate the wires sufficiently to obtain enough reactance for this purpose in the line itself; or, if necessary, reactive coils could be cut in from place to place along the line.

Such circuits, when designed to compound but not to over-compound the voltage at the receiving end, are usually adjusted to give a constant drop equal to the resistance drop under about half-load. If, however, they were adjusted to give constantly no drop, i. e., to have no lagging currents at no load, the reactive drop in the line at all loads having such a phase relation with the impressed e. m. f. as to have no effect upon it, then the pressure at the receiving end of the line would, under all conditions of load, be equal to the pressure at the transmitting end; moreover, the pressure at any and all intermediate points would be the same under all loads. In this way a uniformly distributed boosting would be obtained without boosters, and the same means would give uniform compounding. The disadvantage of such an arrangement over that now used would be the larger leading currents superposed on the energy currents of the rotaries at full load, greatly increasing the armature copper heating of these machines, as well as to a certain extent that of the transformers and line wires under full-load conditions.

ARE SHUNTED WATTMETERS PRACTICABLE?

The necessity for running the full current to be measured through the series coil of the Thomson integrating watt-hour meter when used for direct-current measurements, involves considerable expense in connecting up this instrument in places where the current runs up to several thousand amperes. Often this expense is greater than the cost of the instrument itself, unless the switchboard is specially designed so that the lead carrying the current to be measured need not be diverted out of its course to reach a suitable location for the wattmeter. Often on boards not intended to carry wattmeters, the expense of putting in a long loop for such large currents is so great that to avoid it the meter is located in some inconvenient and inaccessible place behind the board. But more often the expense and particularly the difficulty of connecting up such a meter in circuit without discontinuing service are so great that it is not put in at all, or is used in only one or two places, while without this difficulty it might be much more generally used. This is to be regretted, as a more general use of integrating watt-hour meters on machines, bus-bars, batteries and feeders of direct-current plants would give information of value in many ways and would aid in locating losses and bettering the economy. There is no other instrument giving equally valuable records except a recording ammeter of the Bristol type which, unfortunately, as now made is subject to the same difficulty; that is, the full current to be measured must be passed through it.

The ease of installation of shunt ammeters and of alternating-current wattmeters engenders the wish on the part of most engineers using switchboard instruments that direct-current integrating watt-hour meters or recording ammeters could be wired to shunts through a small shunt coil, such as is used with Weston switchboard ammeters. At first thought, this appears impossible on account of the large number of ampere-turns needed in the instruments and the large drop and consequent loss which would apparently be required in the shunts to force the necessary current through the instrument circuits. But would the drop in a shunt necessarily be increased excessively over that in the heavy leads carrying the whole current from the position of the shunt to the meter? The reduction of the current delivered to the instrument, if the latter were shunted, would, of course, call for a corresponding increase of the number of turns in its coil. These turns, being of a conductor with a smaller cross-section, would theoretically call for a drop in the shunted instrument greater than that in the full-current instrument in the same ratio that the total current bears to that shunted into the instrument. This is assuming that the same ampere turns are developed in the instrument and that the coil occupies the same volume. But need this be the case?

The usual Thomson instrument for large currents is astatic, the series coil consisting of one straight bar running horizontally across the instrument between the two rotating armatures. If made for use with a shunt, this bar would be replaced by two coils surrounding respectively the two armatures, which would immediately make available a greater volume for winding, and thus make it possible to get the same ampere turns in the shunted instrument as in the original full-current instrument without a proportionally increased drop. The drop being of importance, it is possible to take further steps to avoid the necessity of raising it, such, for example, as making the series coil of a conductor of larger cross-section occupying a greater volume. The number of turns in the potential winding or armature might also be increased to reduce the necessary ampere turns of the field or series coil without reducing the torque.

While it would be impossible by any such means to work a recording wattmeter or ammeter from fine shunt coils like those of a Weston ammeter, yet it should be possible to supply it through, perhaps, a No. 0 conductor without excessive drop if the distance from the instrument to the shunt were not too great. It is needless to say that this would be greatly preferable to a conductor of several square inches cross-section, especially on crowded boards with heavy multiple bars of different polarities running close to each other. In some cases, even with the high voltage for a direct-current street railway system, the total output of a station or even of a sub-station becomes so great that one instrument cannot conveniently be made to carry the whole current. Such a case is one of the sub-stations on the street railway system of New York City, the bus-bars of which are laid out with a cross-section of 13 sq. in. for 15,000 amperes. Two watt-hour meters are used to measure the output of this sub-station, one getting one-half and the other one the other half of the current over the main bus. One isolated plant in New York City has bus-bars laid out for 16,000 amperes, the cross-section of the bars being 20 sq. ins.

Telegraph and Telephone Combination.

A rumor from Minneapolis, Minn., is to the effect that the consolidation of the Western Union Telegraph and Postal Telegraph Companies and the Bell Telephone Company is certain of accomplishment. This report, it is stated, comes from a prominent stockholder of the Erie Telephone Company, who is in Minneapolis attending the annual meeting of the Northwestern Telephone Exchange.

Kinloch Long-Distance Telephone Company.

Articles of incorporation were filed last week with the Secretary of State at Jefferson City, Mo., for the Kinloch Long-Distance Telephone Company of Missouri. The officers of the new company, who are all stockholders in the local Kinloch company, are: C. Marquard Forster, president; Rolla Wells, first vice-president; William D. Orthwein, second vice-president; Philip Stock, secretary, and Breckinridge Jones, treasurer. These gentlemen and Adolphus Burch, William J. Lemp, Ellis Wainwright, S. M. Kennard, Charles H. Turner, William F. Nolker, Henry Nicolaus and August Gehner, constitute the Board of Directors. The company is capitalized at $300,000, but this amount, it is said, will be increased to $3,000,000, as soon as arrangements for consolidating the various independent telephone lines in the State are completed. Valuable franchises have been obtained in Chicago and other Illinois cities, and an extensive long-distance service is already in operation in connection with the local Kinloch service.

The bids for the work on the new long-distance lines were opened last week. The contract was let and orders given to go ahead with the work immediately.

Independent telephone exchanges will be established in Missouri and Illinois cities, and arrangements are being perfected whereby the Kinloch company will be able to work in harmony with the other independent companies of the State.

Rumor also has it that negotiations are under way for the absorption of the Kinloch company by the Telegraph, Telephone and Cable Company of America. This is denied, however.

Physics Section, A. A. A. S.

The preliminary programme for Section B (Physics), of the American Association for the Advancement of Science, at its annual meeting, to be held in New York, June 23 to 30, 1900, is as follows: Presidential address by Prof. E. Merritt, on "Cathode Rays and Some Related Phenomena;" G. F. Fitzgerald, on the "Vortex Theory of the Ether;" Edward Atkinson, on "Physics in Connection with Fire Losses;" John A. Brashear, on "Exact Measurements;" Prof. H. S. Carhart, on "Thermodynamics of the Voltaic Cell;" Frank H. Bigelow, on "Studies in Plateau Barometry;" Prof. E. L. Nichols, "On the Visible Radiation from Carbon;" Prof. E. Merritt and O. M. Stewart, on "The Development of Cathode Rays by Ultra-Violet Light;" Prof. W. S. Franklin, on "Some Lecture Demonstrations Bearing upon the Elementary Theory of Elasticity," and on "The Flow of Energy Around a Conductor Placed Near an Electric Current Sheet;" Prof. R. W. Wood, on "The Photography of Sound Waves and the Demonstration of the Evolution of Reflective Wave Fronts, by the Kinematograph," and on "The Application of the Schlieren Methods to the Microscope;" Prof. R. A. Fessenden, on "Some Experiments in Electric Lighting," and on "Circuit Breakers and Induction Coils:" S. E. Moore, on "A Spectrophotometric Study of the Hydrolysis of Dilute Ferric Chloride Solutions;" K. E. Guthe and A. Trowbridge, on "Experiments with the Coherer;" Prof. C. D. Child, on "The Velocity of the Ions in the Electric Arc;" C. T. Knipp, on "The Surface Tension of Water at High Temperatures and Pressures," and on "The Use of the Bicycle Wheel in Illustrating the Principles of the Gyroscope;" Frank Allen, on "The Effect upon the Persistence of Vision of Exposing the Eye to Light of Various Wave Lengths;" H. J. Hotchkiss, on the "Counter Electromotive Force of the Electric Arc." The American Physical Society will hold a joint session with Section B of the A. A. A. S., during its meeting in New York. Prof. Henry A. Rowland is president of the society and Prof. E. Merritt secretary.

The Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society was held on the evening of June 14. The election of officers resulted as follows: President, T. Commerford Martin; vice-presidents, Arthur Williams, F. V. Henshaw, Stephen L. Coles, W. C. Burton, C. O. Baker, Jr., S. L. Nicholson; secretary, Geo. H. Guy; treasurer, Henry A. Sinclair. The secretary's report showed that there is a membership of 540, and the treasurer's report indicated that the society is in excellent financial condition.

Mr. E. W. Caldwell read a paper entitled "Late Advances in Ruhmkorff Coil Interrupters," at the close of which President Dunn gave an account of some work performed by himself some years ago on "Electric Tempering of Steel Wheels," employing therein apparatus which really constituted an enormous Wehnelt interrupter. So powerful was the action induced by the passage of the current from the submerged wheel to the electrolyte that all the members of the party who witnessed the experiments, the next day found that they had been severely burned about the face and hands, showing symptoms identical with sunburn, with subsequent peeling of the skin.

Prof. Doremus exhibited one of the original coils used by Prof. Henry in his classical experiments on self-induction. Mr. Mailloux called attention to the fact that the term "Impedance" was first used publicly at a meeting of the society in 1882 or 1883, and that many other classical researches had been introduced to public attention through the medium of the same body.

Export Trade with China.

The address of His Excellency Wu Ting-Fang, Chinese Ambassador to the United States, which was delivered at the banquet during the recent convention of the National Association of Manufacturers, in Boston, contained some statements of interest to American electrical manufacturers who are looking to China for a further development of their trade. Mr. Wu Ting-Fang, in the course of his remarks, said: "We need your modern mechanical appliances to supplant the slow processes of production. Again, we have thousands of miles of railroads to be built. We need your rails, locomotives and iron bridges. Suffice it to say that the market is vast enough for every line of American goods." In order to obtain a due share of the China trade, it seemed to him that there are two courses open to the American manufacturer: "The first one," he said, "is that you should go to China to show us what you have to sell. We are a practical people; we take nothing on faith; we have to see what we buy and we buy only what we want." He stated that he had always advocated the establishment of an exposition in Shanghai, and in other treaty ports for the display of American goods. On a better acquaintance of American goods, he predicted that American manufacturers would find the Chinese people to be good customers. He advocated inducing Chinese merchants to visit America and be afforded every facility to visit the great commercial centres and inspect the factories, mills and other establishments in this country. "If Chinese merchants could come more freely to this country and see how things are done," he said, "it would certainly give them a greater respect for American methods."

Pan-American Congress.

In accordance with the suggestion of President McKinley in his annual message to Congress in December last steps are now being taken to hold a Pan-American Congress. During the past week, representatives of Latin-American countries met the Secretary of State and Director of the Bureau of American Republics, in Washington, in connection with the proposed Congress. The President of Mexico extended an invitation to hold the Congress in the City of Mexico, and it is stated that all but two of the delegates voted in favor of this proposition. The date of holding the conference has been left to the decision of the United States and Mexican Governments. One of the objects of the proposed conference is to promote the commercial relations between the countries concerned.

The United Electric Light and Power Company of New York City.

THE United Electric Light & Power Company of New York City has the most extensive distribution system in the metropolitan city, its ducts completely covering the main arteries of the city, and reaching out in all directions from the Battery to 159th Street. The company was formed several years ago by the amalgamation of various smaller lighting companies, among them the United States Illuminating Company, which was one of the first to supply commercial electric lighting in the city.

The power stations of the old companies acquired by the new company upon amalgamation, had been in service for several years, and the apparatus was somewhat antiquated. In 1895 it was determined to erect a new central power station, embodying the latest electrical improvements, and to abolish all the older ones. The engineer of the company, Mr. H. W. York, designed and superintended the erection of the new station, which is equipped with Westinghouse apparatus throughout. At that time 3000-volt generators represented the most advanced electrical practice, but these have since been eclipsed by larger machines at higher voltages, such as the eight units of 5000 kilowatts for the Manhattan Elevated Railroad, New York, now being constructed.

The central station of the United Electric Light & Power Company is situated close to the East River, between Twenty-eighth and Twenty-ninth Streets. The district first supplied with light and power extended from the Battery to Fifty-ninth Street, and the position of the power house was thus very central; but now the lighting circuits have been extended to 159th Street. Economy of space is one of the prime considerations in laying out work in a large city where property is so valuable as in New York. This station, designed for 20,000 horse-power of engines, with the necessary boilers, pumps, heaters, condensing apparatus, dynamos and switchboards, and storage for 6000 tons of coal, has an area of 160 ft. 11 ins. by 197 ft. 6 ins. All the machinery, including the boilers, is on the ground floor, and yet there is ample light, air and space for working around the apparatus, both for ordinary operation and for effecting repairs.

Half of the plant, 10,000 horse-power, has already been erected, and it is probable that in the near future the remainder will be provided by erecting four Westinghouse-Parsons steam turbines, each of 2500 horse-power direct connected to generators of 1500 kilowatts each, working at 1200 r. p. m. The first of these units is already constructed, and is undergoing preliminary tests in the works of the Westinghouse Machine Company at East Pittsburg.

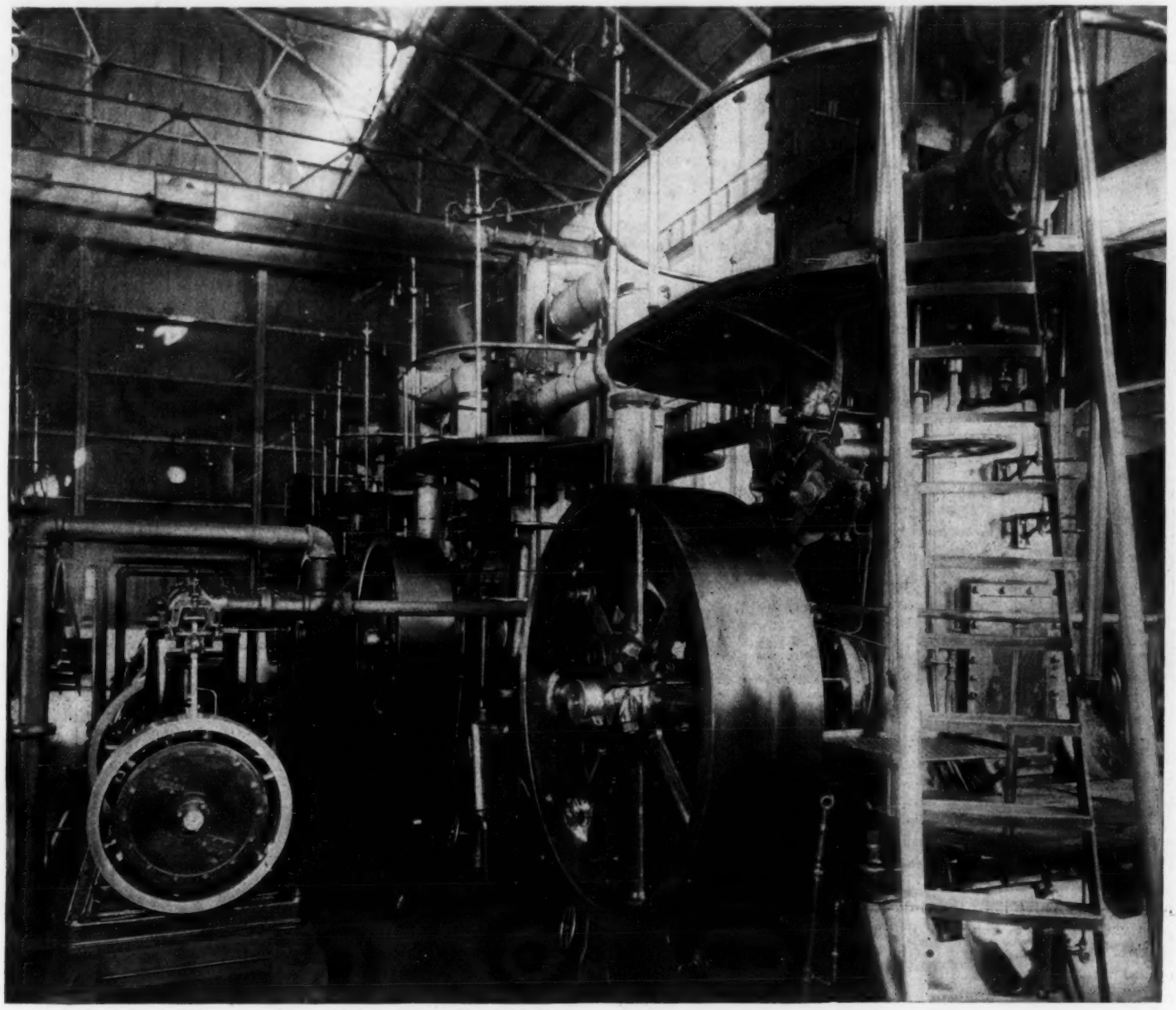


FIG. 1.—GENERATING ROOM, UNITED ELECTRIC LIGHT & POWER COMPANY.

The power house has a frontage of 160 ft. 11 ins., being a steel frame structure with a brick filling in the walls. Provision is made to prevent the noise of the machinery annoying the patients in Bellevue Hospital, which is directly across the street. The entire front of building has a double wall carried up above the roof, the outer one being 12 ins. thick, and the inner one 8 ins. thick, with a 2 in. air space between them. These two walls are bonded together at every sixth course vertically by bricks spaced 20 ins. horizontally. Double windows are used on this side of the building, and the deadening of sound is so very effective that when standing directly in front of the building, it is impossible to tell whether or not the machinery is in

operation. To prevent the transmission of vibration to adjoining buildings, the foundation walls were built with an intervening space of one inch, which was subsequently filled with sand, level with the surface of the ground.

The boilers, which are of the upright, water-tube type, consist of twelve units of 600 horse-power each. Apart from being economical in the generation of steam, this type of boiler was selected because it occupies so little floor space. Each boiler contains 588 tubes, 11 ft. long and 3 ins. in diameter. The boilers generate a steam pressure of 150 lbs.

The engine and dynamo room, shown in Fig. 1, contains eight units for generating purposes, and three exciter units. The engines were constructed by the Westinghouse Machine Company, East Pittsburg, Pa., and are double-acting, known as the "Columbian Steepled Compound." They are of the same type as those used in the lighting station at the World's Fair at Chicago; in fact, three of these engines were in service in the Chicago Exposition. The low-pressure cylinder is placed over the high pressure, and both pistons are connected to

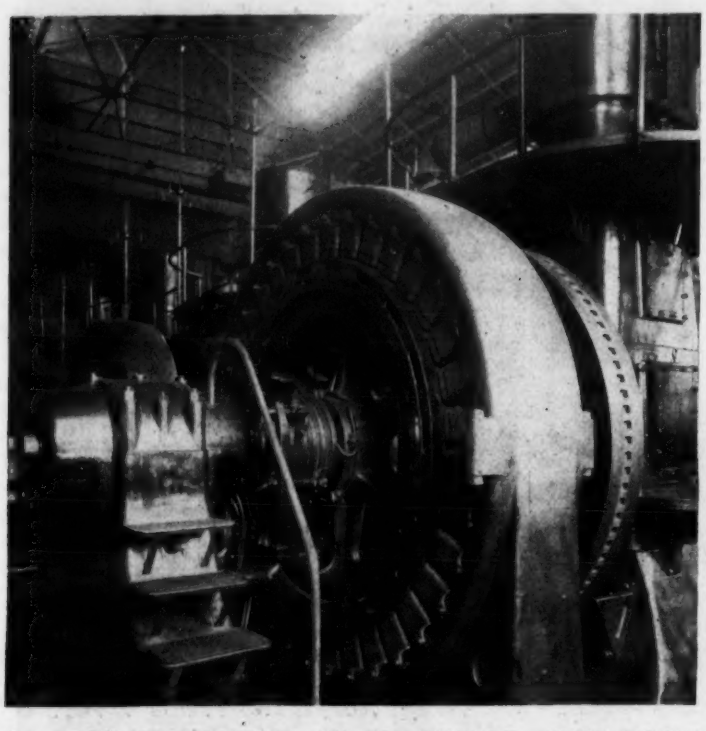


FIG. 2.—750-KW, TWO-PHASE, 3000-VOLT GENERATOR, UNITED ELECTRIC LIGHT & POWER COMPANY.

the same rod. A crank is enclosed in the same manner as is customary in the familiar types of Westinghouse engines. The low-pressure valve is operated by a fixed eccentric placed inside the crank case, while the high-pressure valve receives its motion from a shifting eccentric outside the crank case, operated automatically by the governor, which is placed on the shaft outside the eccentric. The low-pressure valve is of the slide-valve type, while that for the high-pressure cylinder is a hollow piston valve, being constructed in this manner to allow the exhaust from the lower end of the high-pressure cylinder to pass up through it. The dimensions of these engines are as follows: Diameter high-pressure cylinder, 21½ ins.; diameter low-pressure cylinder, 37 ins.; stroke, 22 ins. The speed is 200 r. p. m. and the rated horse-power 1200 when operating condensing, with 150 lbs. initial steam pressure.

Each of the eight generating engines, one of which is shown in Fig. 1 is direct connected to a 750-kw, two-phase, 3000-volt Westinghouse generator. Each engine and generator is set on a firm cast-iron bedplate, the armature being mounted on the engine shaft. The generator has but one bearing, the armature being swung between the engine and this single support. These eight units are operated in parallel, supplying current to the main bus-bars of the switchboard. The generating units are arranged in two rows of four each, an enlarged view of one being shown in Fig. 2. There are three exciter units consisting of 75-kw direct-current Westinghouse dynamos of the railway generator type. These are directly-connected to three 100-hp Westinghouse single-action tandem-compound engines by means of a flexible coupling. Three of these outfits are provided, and as each has sufficient capacity to excite four alternators, there is always one to spare.

When this new station was completed, the older power house adjoining it on Twenty-ninth Street was shut down, the machinery and apparatus being offered for sale. Recently the demand for current has increased with such rapidity that this station has been re-equipped. Three new Westinghouse generators of 400 kilowatts each, two-phase, 3000 volts, are belt-driven by the three Corliss engines belonging to the old plant. This station, a view of which is given in Fig. 3, delivers its current to the bus-bars of the switchboard common to the two stations, the two power houses thus working in parallel. The chief engineer has devised an ingenious device for controlling from the switchboard the speed of the eight large engines in the Twenty-eighth Street station.

Three feed pumps are provided, any two of which suffice to supply all the boilers. City water is used, supplied by meter. The steam supply is controlled by a regulating valve operated by the pressure in the feed mains, so that this pressure is always kept constant. The engine and dynamo room is spanned by a three-motor electric crane of 25 tons capacity. The span from centre to centre of the rails is 72 ft. 4 ins., the crane weighing approximately 45 tons.

The coal and ash handling machinery consists of an endless chain of gravity buckets, which are loaded by means of a filler, and can be dumped at any desired point of the coal bunker. The driver is in the north end of the ventilator over the coal bunker. The coal filler is in a vault under the sidewalk, and the coal is dumped into this apparatus through a grating situated at about the street level. After being deposited in the buckets, the coal is carried up into the ventilator over the coal bunker and dumped into any portion of the bunker desired.

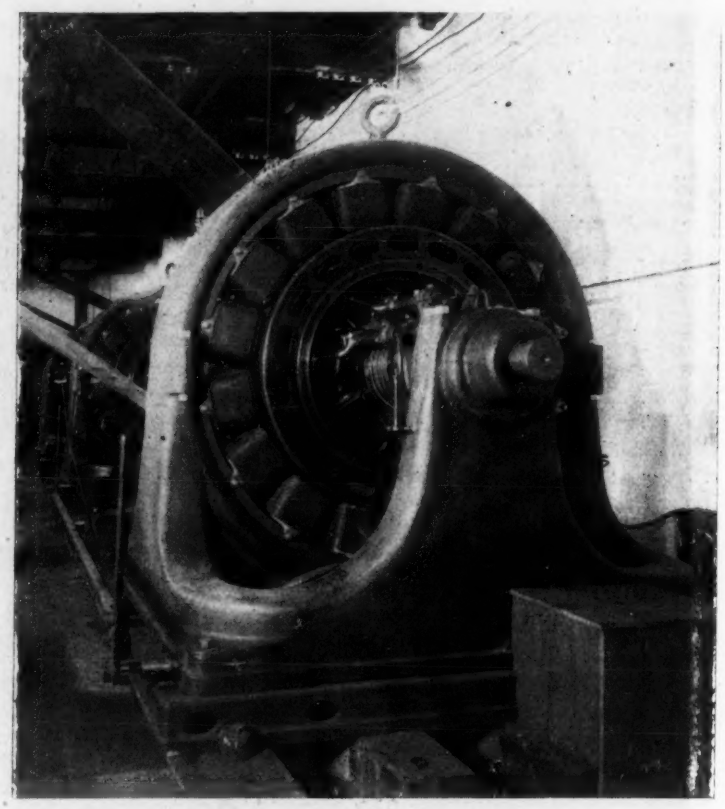


FIG. 3.—400-KW, TWO-PHASE, 3000-VOLT ALTERNATORS, UNITED ELECTRIC LIGHT & POWER COMPANY.

From the hoppers in the bottom of the bunker, the coal is spouted to the different boilers. The arrangement is such that the coal trims itself, and will continue running down the spouts without assistance, so long as any remains in the bunker. When the Twenty-ninth Street side of the station is built, a second conveyor running at right angles to the present one will be put in to bring the coal from the water front.

Under each boiler is an ash hopper delivering ashes to a second movable filler, which deposits them in the buckets of the conveyor, when it is not used for coal. The conveyor dumps the ashes at a point from which they are spouted over to a tank in the southeast corner of the coal bunker. From the tank they are spouted down and out through the front of the building into carts.

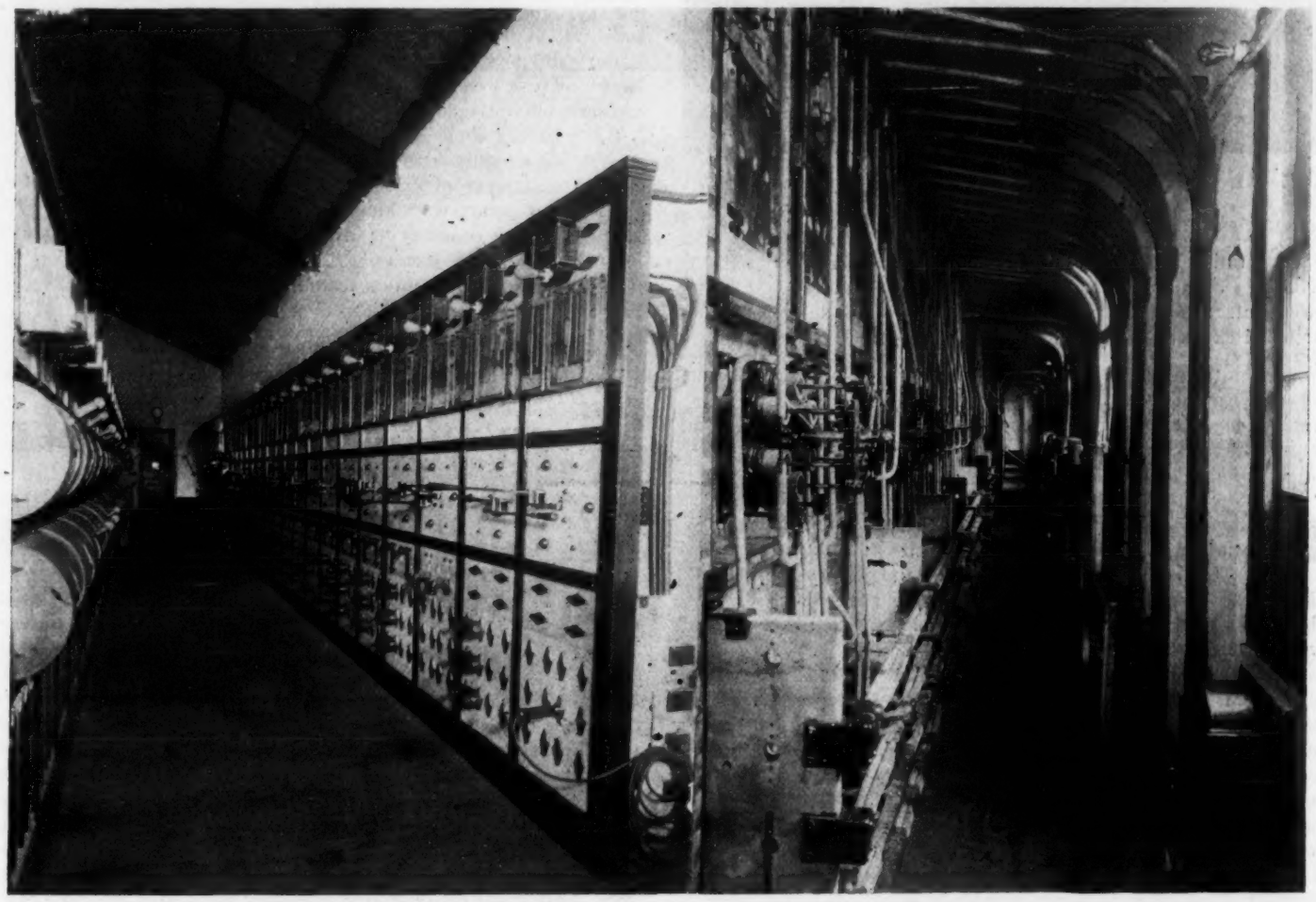
A feature of special interest in this station is the arrangement of the steam piping. Being laid out upon a loop system, the size of the pipes is reduced to a minimum; and although there is no duplicate set of pipes, steam can be shut off any portion of the system without interfering with more than one engine or its equivalent boiler capacity. As this amount of spare is always carried, it follows that any portion of the steam piping system can be cut out without interfering with the operation of the station, and the loop system fills all requirements without a duplicate set of pipes. The boiler feed water is passed through two heaters using exhaust steam from the engines, which raises the temperature to about 200 degs. before entering the boilers.

Another special feature of the steam piping of this station is the use of a combined separator and receiver placed close to each engine. This receiver contains six times the volume of the high-pressure cylinder of the engine, and as the cut-off is one-third stroke, it follows that at full load there is at the engine 18 times the volume of steam required for one stroke. This reservoir prevents the excessive drop in pressure in the pipe when the valve of the engine opens, and a corresponding rise above boiler pressure when the valve closes, and keeps a practically uniform flow of steam in the pipe in one direction, allowing the use of smaller pipes than would otherwise be required, and doing away almost entirely with the vibration in the pipes caused by the intermittent flow of steam. In the basement below the engine room are two Worthington jet condensers of 5000 horse-power, each of which uses water pumped directly from the East River.

Although provision is made in the new station at Twenty-eighth Street for the switchboard and its accompanying apparatus, the switchboard room of the Twenty-ninth Street station has thus far been used, and the board modified to suit the new requirements. Views of the switchboard room are shown in Figs. 4 and 5. The switchboards are arranged in two rows with a 6-foot passage between them. The boards consist of 11 generator panels and 16 feeder panels.

The lead wires from the machines are lead-armored cables run in iron ducts directly from each dynamo to its panel on the dynamo board. On this board each alternator as well as each exciter has its own panel equipped with the customary appliances, including voltmeter, ammeter, rheostat, fuse blocks, switches, etc. From each panel on this board connection is made to a pair of bus-bars on the back and running the length of the feeder board, and here each circuit has a separate panel equipped with a voltmeter, ammeter, continuous-registering meters, etc. From the feeder board the circuits run to a third board called the cable terminal board, where, after passing through fuse blocks and a second set of switches used for transferring any circuit from its own panel to a spare panel provided in case it is desirable at any time to cut any feeder panel dead, they enter the subways. The entire distribution system throughout the city is underground, and occupies about 200 miles of ducts. The voltage is reduced to the desired pressure by means of transformers placed at the points of distribution, usually in vaults under the sidewalk. Continuous-registering wattmeters are employed to determine the amount of current consumed.

The Westinghouse high-tension plunger switch seen in the foreground of Fig. 5 has been adopted on account of its simplicity and efficiency. These switches break the circuit quickly at two places in series in each leg of the circuit, thus dividing by two the pressure at the breaking points. The break is made in a small enclosed air chamber, thereby limiting the expansion of the arc, and creating a strong lateral draft through a vent provided for that purpose, supplying a ready suppression of the tendency to arc.



FIGS. 4 AND 5.—SWITCHBOARD, THE UNITED ELECTRIC LIGHT & POWER COMPANY.

These switches have a cast-iron frame mounted upon the back of the marble base which serves as a support for the porcelain cylinders, and as a guide for the operating rod which passes through the frame, and is controlled by a handle in front. The long handle furnishes a powerful leverage, and promotes ease and certainty of operation, while the fact that the handle is on one, and the switch terminals on the other side of the marble slab, insures absolute safety to the attendant. Each cylinder has a one-half-inch bore, through which a copper rod or plunger passes to make the electrical contact between terminals. The resistance and consequent losses in these contacts are kept very low, contact being made on all sides of the cylindrical plunger. Heating is thus prevented, and the efficiency of the switch kept high. There is a small outlet from the centre of the porcelain tube through the supporting iron bracket. The porcelain cylinders are all made interchangeable.

The plungers are supported by an iron crosshead rigidly secured to the operating rod and moving with it. The plungers are self-aligned and entirely insulated from the iron crosshead. It is evident, therefore, that the only charged metal on the switch consists of the plungers and the terminals on the porcelain cylinders. The cross-

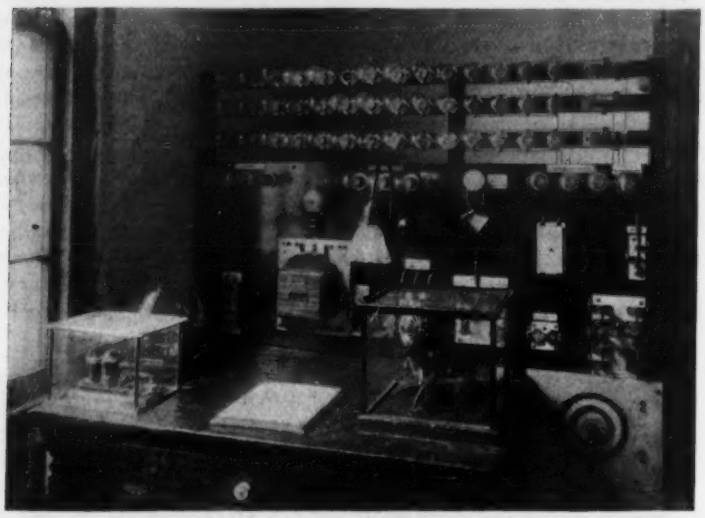


FIG. 6.—THE ELECTRICIAN'S OFFICE, UNITED ELECTRIC LIGHT & POWER COMPANY.

head, operating rod and handle are completely insulated from all live metal. In opening the switch, the plunger is withdrawn from the lower contact, and the arc which tends to follow it is destroyed by the combined effect of the cooling action of the porcelain walls and the draft caused by the heated air escaping through the outlet from the porcelain tube. Fig. 6 shows a corner of the electrical engineer's office, which is amply furnished with means for supervision.

This station has been in constant operation since September, 1895, and the load has been continually increasing, as circuit after circuit has been cut over from the old system to the new, and new business has been secured. At present, current is supplied for about 200,000 incandescent lamps of 16 candle-power, 2000 arc lamps and power for 3000 horse-power of Westinghouse type "C" induction motors, which are employed for various purposes, such as driving pumps, operating blowers for church organs, furnishing power for sewing machines, for ventilating fans, for printing presses and for almost every conceivable industry.

A greater part of the lighting is for 105-volt lamps, but a new departure has recently been made by the introduction in Lexington Avenue of a circuit of series enclosed arc lamps, manufactured by the Manhattan Construction Company. These lamps are of 2000 candle-power, and are supplied with current at 3000 volts without the intervention of transformers. This installation was put in experimentally, but its success is such that arrangements are being made to substitute at least 2000 lamps of the same description between the Battery and Fifty-ninth Street, in place of the present direct-current lamps. These new lamps run for 50 hours without trimming and consume 440 watts per hour.

When this station was designed, architectural beauty was not sought, but a highly serviceable station was desired, capable of delivering a maximum of current on the most economical conditions. These latter points were attained. As already mentioned, it is the intention of the company to install a further 10,000 horse-power to meet the continually increasing demand for current for lighting and power purposes. In addition to the use of turbo-generators, several improved methods will be introduced in accordance with the most modern practice.

Independent National Telephone Convention.

THE fourth annual convention of the Independent Telephone Association of the United States, which was brought to a close in Cleveland last Thursday night—or, more properly speaking, at 3 a. m. Friday morning—will long be remembered by those who participated as a most enjoyable occasion, as well as a most instructive one from a business and practical standpoint. The convention and the exhibition of telephone appliances were held on the first, second and third floors of the new "Electric Building"—the headquarters of the United States and Cuyahoga Telephone Companies—the sessions of the convention being held on the first floor.

On Monday afternoon there was a preliminary meeting of the members of the Independent Telephone Association of Ohio at which it was decided that the members present should act as an entertainment committee to assist the regular entertainment committee, of which Mr. Charles Wason, of the Cuyahoga Telephone Company, was chairman, in looking after the wants of those from outside of the State.

Monday evening the advisory board of the Independent Association met, and looked over the papers that were to be read at later sessions. Tuesday morning was spent in registering and issuing credentials and in getting acquainted.

TUESDAY'S SESSION.

At 2 o'clock Tuesday afternoon the first session of the convention was called to order. The address of welcome at the initial session was delivered by Mr. J. B. Hoge, secretary of the United States Telephone Company.

Mr. Hoge extended to the delegates a cordial welcome, and stated that everything possible would be done to add to the enjoyment and pleasure of those present. He referred to the encouragement and inspiration that the convention would bring to the independent movement, and also to the wonderful progress that has been made by the independent companies during the past few years. In concluding his address, he referred to the scope of the long-distance company of which he is secretary, the long-distance lines of which reach most points in Ohio and make connections with the independent exchanges in New York, Pennsylvania, Kentucky, Indiana and Michigan, while in a few weeks connections will be made with the various companies in West Virginia. To-day the lines connect with some 540 stations in Ohio, and with fully 37,500 telephones, and many additional subscribers are being added every day.

The response was made by Judge Thomas, president of the association. He said that the body had not always had the pleasure of meeting at places where entertainment was given by local people, with the exception of what had been offered in the city of Chicago and the city of Detroit by the people who were directly interested. The first year the people of Detroit kindly entertained the convention; the second year the city of Chicago offered no entertainment, but last year the manufacturers and supply people of Chicago kindly donated a large fund for the entertainment of the convention. The proposition was made the association that it meet this year in the city of Cleveland without expense to it. In conclusion, President Thomas said: "I am not going to make any pledges for the entertainment, but if any one stays through the entire session and is not satisfied at the close of the banquet on Thursday evening, he will please step to the doorkeeper, who will refund him the money for the banquet and supper."

The session then adjourned, and the afternoon was spent in examining the exhibits of the manufacturers of materials and apparatus, which were arranged on the second and third floors of the building, and in several rooms at the Colonial Hotel, nearly opposite. A number of the delegates took advantage of the hospitality offered by the American Steel & Wire Company, and visited the several plants of that concern in the city.

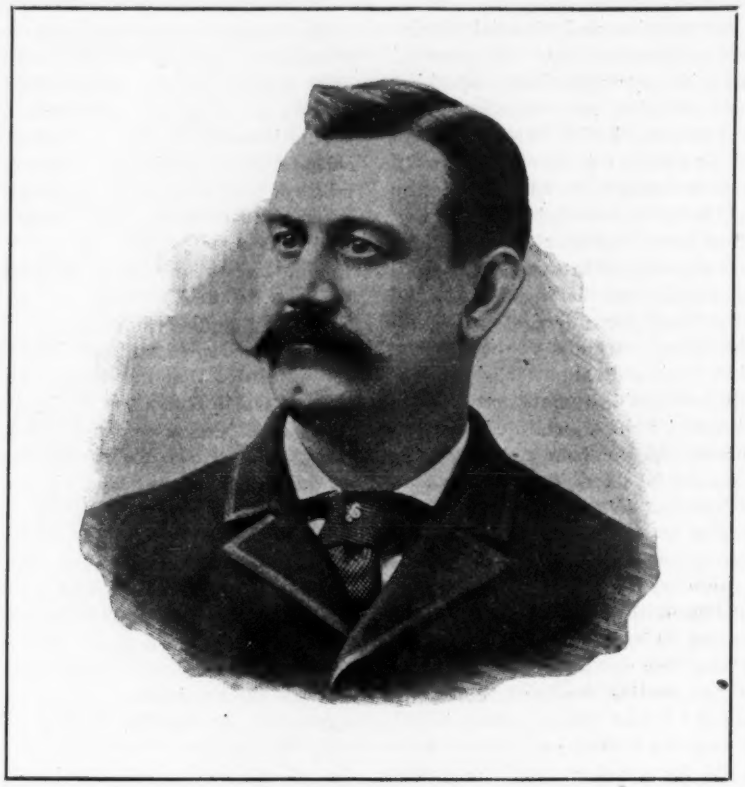
On Tuesday evening a reception was given by the Cuyahoga Telephone Company, at which time an opportunity was given for the inspection of the new exchange and offices of the company. Officials of the company and their wives received on the seventh floor of the building, and this and the exchange room was a perfect bower of beautiful flowers, while an orchestra rendered delightful music. Refreshments were served, and the entertainment lasted until midnight.

WEDNESDAY MORNING SESSION.

The convention got down to real business on Wednesday morning. Judge James M. Thomas opened the session with the annual presidential address. Before commencing the address proper he said

that he took great pleasure as president of the association in acknowledging on its behalf, the great assistance that had been rendered by the many who had taken more than usual interest in the success of the meeting, including the local daily press, the electrical journals, both in New York and Chicago, and the many newspapers throughout the country. He stated that more than 1500 operating companies had complied with the request to furnish a detailed statement of their properties, and he acknowledged the service rendered by manufacturers and supply companies in assisting to perfect the list of operating companies. Thanks were given to the Cuyahoga Telephone Company for the liberal donation of space in its building; also to the Telephone, Telegraph & Cable Company, of New York, for financial assistance. Special thanks were also given to the local entertainment committee and local manufacturers and supply houses for the arrangement of the many pleasures that were to be enjoyed.

Judge Thomas recalled that the annual address of last year contained the following prophecy: "The coming year will be one of interest and importance to both sides," and added that all are more or less aware how this has been fulfilled. Among the important changes that have taken place in the telephone field during the past year, he mentioned the following:



JUDGE J. M. THOMAS,
PRESIDENT INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION.

The entire property of the American Bell Telephone Company has passed into the hands of the American Telephone & Telegraph Company, the headquarters of which will soon be removed to New York City. The Detroit Telephone Company and the New State Telephone Company, of Michigan, formerly independents, have been sold to the Erie Telephone Company, a part of the Bell system. The New Orleans exchange, owned by the Michigan people, has been sold to the Southern Bell Company. The controlling interest in the Erie system has since been bought up by the Telephone, Telegraph & Cable Company of America, an independent thus securing control of the largest Bell licensee. The Massachusetts Telephone & Telegraph Company is building an independent plant at Boston, and has a strong foothold throughout the State. The Boston & New York Telephone Company, an independent, is to build a toll line between the cities mentioned. The organization of the Telephone, Telegraph & Cable Company of America has attracted more attention than any single organization in the past year. The Interstate Telephone & Telegraph Company, of Philadelphia, is building toll lines in Eastern Pennsylania and New Jersey. The Keystone Telephone & Telegraph Company is building an exchange in Philadelphia. The Virginia Long-Distance Telephone Company is to build toll lines in Virginia. The Central Telephone & Telegraph Company is pushing the movement in Iowa. New franchises have been granted in San Francisco, Kansas City, Scranton, Pa., and a large number of other cities. New exchanges have been opened at Cleveland, Wilkes-Barre, Pa.; Duluth, Minneapolis, St. Paul, and many other cities. Exchanges are under way in Columbus, Pittsburg, Baltimore and a host of smaller cities.

Judge Thomas stated that there are not less than two and one-half million telephones in the United States, counting both the Bell and the independent systems, but he believes that with the present population of the United States, seven million telephones could be used at reasonable prices. The Bell Telephone Company, he said, was nearly twenty years in building up a demand for 582,506 telephones. Since the beginning of the independent movement six years ago, nearly two million telephones have been added to this number. It will take at least seven hundred million dollars, he said, to install all the telephones that our present population require. "When we think of these possibilities, the broad expanse of territory, our great population, the almost incomprehensible number of dollars that it will take to supply a demand that can be created, we wonder how it is possible that men should take a narrow view of the subject and allow themselves to waste their time and money in territorial warfare. There is ample territory for all, and certainly a place for every dollar there is to invest. What we need more than anything else at this time is good clear business judgment which will devote itself to this great work. There is always room in any town or surrounding country for an independent telephone system providing there is no company occupying that territory except a Bell licensee, but no territory is large enough for two independent companies. This is a safe and simple rule to follow, and, if followed, will be for the good of the investor. I have never known two independent companies to enter the same field without loss, while one opposed to the Bell Company, though the Bell Company may give free service, always flourishes. Why? Because the policy of the independents being the same, injury is always the natural result, while the old policy of the Bell companies in every instance assists the independents to a good and paying business."

He said that the opinion should not be indulged in that the Bell interest is not managed by men of ability, since some of the concerns are managed by men of great tact and ability, and were it not for the fact that they have been hampered for years by a short-sighted policy of the parent company, they would have been almost impregnable before the independents entered the field, and by a continuance of this policy, the individuality of the officials is lost.

Judge Thomas considers that no business has ever thrived long as a monopoly without government protection, until by proper organization the thing has been placed within the reach of the people at prices below those that could be made by opposing companies. A minimum price to the consumer, a full supply at that price, will naturally create a monopoly of that thing. When a great organization can gain control of the business of conveying intelligence by wire, furnishing a sufficient supply for the demand, then it will be possible for the business to be controlled by one company; but that can come only after full development under competition such as is now afforded by the independent movement. There is no more economical way to develop the telephone business than by competition.

As to the frequent remark that two telephone companies are a nuisance and that people do not want competition, Judge Thomas said that he had never heard business men who had use for two telephones talk that way, and that such remarks are generally from the stockholders and officers of the first company on the ground. The man who only has use for one telephone, of course, does not need two, but every man needs at least one in his home and one in his business. Some need more than one in their residence, and many need two in their business. The large business houses in all cities, hotels and factories, need a complete system of many telephones in order to facilitate their business. This demand is growing every day, and as the new demand, under the new policy which has been established by the independents, is fully supplied in the different communities, the number of users has multiplied four or five times, and the capacity of one telephone cannot properly handle the business. Then business houses that had little use for one telephone are found to be anxious for two or more. When two or more are required, and

there are two good systems in a town, it is the policy to be connected with both, so that this business may be reached by all the different users in the community. When the value of the telephone in the business and social world is considered, it seems strange that the growth of the business should be retarded longer by the selfish policy of the grasping dominating corporation.

He dwelt at length upon the possibilities of the telephone in the future, and expressed the opinion that the independent movement had been entrusted with the work of giving the invention to the people at fair prices. He said it seemed hard to comprehend that since the birth of the independent movement, more than three thousand independent exchanges have been placed in operation and nearly one million telephones connected.

To give the greatest number of advantages to all classes of people, Judge Thomas expressed the opinion that measured service solved the problem in the most practical means. He admitted that this was not easy to place in operation, but thought it the only fair way, and extremely advantageous in the large cities where extremes of service are demanded. He opposed the use of party lines in the strongest terms, and advised the independents to hold to the idea of exclusive circuits, adding that Bell party lines invariably helped the independents.

He advised the use of the best construction and material obtainable and the employment of none but first-class men. A practical manager and a skilled electrician, he said, were necessities. Speaking of operators, he said that they should be ladies, and treated as such; the manager should not be permitted to quarrel with or reprove them in the switchboard room. To give first-class toll service, he stated that the construction must be the best throughout, and in order to give the best service, the business must be handled economically. To this end, there should be a head to have absolute control of interchangeable business. He pointed to the success in this line attained by the railroad companies, traffic associations having been found both economical and effective. He advised the organization of similar traffic associations for handling the toll business of the country.

In conclusion, Judge Thomas said: "This central power would lead not only to a stronger bond of union, but would promote better developments in many communities, and would result in well-defined territorial limits which would be conceded to the company occupying that territory. Territorial limits should be fixed for toll-line companies in most instances by State line, but in some instances great physical lines are more natural, and in others great commercial centres will naturally require contiguous territory. This central power would place us upon an equal footing with the other companies engaged in the rapid communication by wire. Then, with the advantages enjoyed by no other companies in this line afforded us by local interest, we become stronger than any and all others combined. Then we can rest assured that the changes that the future may bring forth will not leave us without power. If the conveyance of intelligence by wire is to be owned and controlled by one organization, let it be under the policy adopted by the independent telephone men of this country. Under this policy has been the greatest advancement, though only six years have elapsed since its adoption. Upon this rock can be built the greatest commercial structure the world has ever known. It will be grand and enduring, and more than gratifying to its owners and builders."

The first paper of the day was that of Mr. J. B. Ware, of Grand Rapids, Mich., secretary and general manager of the Citizens' Telephone Company of that city.

Mr. Ware said that the toll-line or State-line business, while interesting and profitable, is, in many ways, perplexing. To get proper results permanently, strictly first-class construction is required; to quickly and smoothly handle the business offered, not only good office equipment and office force under proper rules and management are required, but sufficient circuits to enable the handling of all calls with despatch. Until ample circuits are provided, no one can tell what the volume of toll business in any locality might be. As far as Mr. Ware can learn, no instance is on record where more toll circuits are in service than are needed; nor a case where toll business has not proven a good investment where more than one circuit was in operation on the line.

The topic under greatest consideration in connection with the toll business however, whether among the smaller companies or the larger, is how to handle economically the toll business itself, the reports and settlements from each office, and especially the settlements among various companies for business passing over several lines.

Such a variety of conditions exist, local to each exchange, that no unvarying rule can be made for local toll rates, i. e., within fifty miles of a large exchange. It is probably conceded that a rate less than a regular schedule or scale rate will bring more income than otherwise in such local territory. Beyond the local limit of fifty miles rates should be made on air-line distances. While it is true that telephone business travels with the railroads largely, yet the time has come when only by air lines can uniform results readily be obtained. Exceptions as to rates between large cities and important towns will from necessity be made, but only prove conclusively the rule, that rates should be according to air-line distances.

The time that the line is used by a subscriber is an element to be considered in making rates, keeping in mind that the average message occupies less time than is consumed in getting the two parties connected and talking. Therefore the unit of time for a conversation should be not one minute or five minutes, but the duration of the average conversation as shown by actual experience and each additional minute consumed in the conversation should be paid for. After considerable investigation and experience, Mr. Ware concludes that three minutes is the proper unit for a conversation, and he believes that it is only a question of time when all toll business will be conducted upon a unit basis of three minutes or less.

The mileage rate is one that should be determined by a competent traffic committee representing all sections, after careful investigation, and such mileage rate should be used for all interstate toll business. For State business, great advantages would accrue by reason of a uniformity in using the same basic rate, but the varied conditions of population and commerce makes this uniformity impracticable for perhaps years. The advantages to be gained by early establishing a uniform time unit and rate charge for all interstate business, are apparent and scarcely need attention. Any manager could thereby apply the scale to the map and instantly tell the rate from his exchange city to any town in another State, provided a special rate was not listed in a regular tariff book. The same system can and should be applied to State rates. A standard map and rate scale should be adopted and put into operation promptly, and Mr. Ware recommended that the association should take action to establish a general traffic committee. The association could also best solve the other great problem—*the division of toll fees.* Much has been accomplished in this direction during the past year through the efforts of the larger toll companies in the States of Indiana, Ohio, Pennsylvania and Michigan, and a traffic committee organized through their influence and co-operation, having for its object the handling of all the toll business in these and other States.

That an exchange should receive a larger commission on outgoing business than does a toll station, is apparent, when one remembers that the toll fee is collected by the agent at a toll station at the time the service occurs, and but one record is made. With an exchange, the making of the "slip" record, the posting to the individual subscriber account, the getting out and collecting of the subscribers' toll bills at the end of each month, the enormous distances traveled in collecting said bills—all these and others make necessary a larger percentage to an exchange than to a toll station, to say nothing about the large investment in the exchange, as compared with the toll stations. Mr. Ware believes a 15 per cent commission to toll offices, and 25 per cent to exchanges, with the maximum fee upon any one message 10 or 12 cents, is fair, the commission being upon any regular "out" message, the commission and maximum applying to extra time service, so that when a customer pays, for example, a double fee by reason of excess of time, the exchange gets the corresponding increase in its amount of fee.

As the messages increase in distance traveled, it becomes necessary that a maximum must be made for the fee on originating business. This is the more apparent when one remembers that the greater the distance, the more switching necessary, and the greater the time necessary to get the subscribers ready to talk. After the exchange or originating commission is deducted, the remainder of the fee should be distributed according to mileage, each company on whose lines the message passes getting its share proportioned to its mileage. Ignoring the actual route traveled, and considering only the air-line distances between point of origin and of destination, or junction point on each system or line handling the message, one can readily determine the proper division of the fees, after tables have been prepared showing distances between various terminals.

Mr. Ware believes that settlements should be made between the companies direct, for all business done over two companies' lines. The settling of the two line messages by the companies interested would at once care for the very large majority of messages. A clear-

ing house in each State might most economically handle settlements for the three or more line messages within the State, and a general clearing house be established for all interstate business. By judicious grouping of States, all three or more line messages can go, to greatest advantage, to one central office or clearing house in each group. Thus, Ohio, Indiana and Michigan messages passing over three or more lines, could go to one central office to advantage, which might well also be the interstate clearing house, perhaps, for all business passing between States.

Uniform blanks and reports are of extreme importance, and will simplify business between companies and secure system, which is now lacking with some companies. With uniform blanks, scales, reports, office books, etc., uniformity will be secured in methods of handling the toll and exchange business not otherwise possible, and largely overcome what has so far retarded this feature of the telephone business.

While toll construction and the standardizing of apparatus are topics that should be considered, the writer does not feel at liberty to take up these branches of the business in this paper, but cannot refrain from urging that uniformity in toll apparatus must be secured.

The manufacturers having so far failed to adopt a standard, the Telephone Association should take steps at this time to secure the end indicated.

Mr. Ware called special attention to the injustice of the goverment war tax upon certain telephone messages. No satisfactory reason can be given why the tax on a telegram costing 25 cents or more for each ten words should be charged to the sender and not to the telegraph company, while a telephone message, occupying from three to five minutes or more, should be taxed against the telephone company, provided the fee is 15 cents or over. There is no such reason, and a great injustice is being done because of such an arrangement. An effort was made at the time the 15-cent minimum was fixed, to have the same increased to at least a 25-cent minimum, but without result.

The fact that the Bell companies as a rule had no message fees less than 25 cents (except where competition forced a lower rate, and then only in limited territory), while their regular message fees ranged from 25 cents to as many dollars, explains why the fixing of a 15-cent minimum is not burdensome upon them, and why they may take no steps to secure a repeal of the act because of the effect upon the smaller independent companies. At the time the war revenue measure was passed by Congress, the independent companies, owing to the short distance reached by their toll lines, had few messages on which they were receiving 25 cents or more, and 15 and 20-cent messages were the rule where a 10-cent fee was not charged. A tax of one cent upon a three-minute message from Grand Rapids to Chicago, for which the Bell Company received $2; or to Boston with a fee of $9; or to Fort Wayne (a distance of 150 miles), with a fee of $1.50, is of comparatively little moment to the Bell companies, yet the same tax per message becomes an unjust burden when placed upon any class or companies where 15 and 20-cent messages predominate, as is probably true of a majority of the independent telephone toll companies. Mr. Ware called upon the association to use its utmost endeavors to obtain the repeal of this portion of the war revenue law.

Mr. Ware's paper was the only one read which provoked discussion, and several gentlemen asked for further opinions relative to the division of toll charges. The view was expressed that in some cases where messages were for short distances only the percentage plan of division would prove more satisfactory than the mileage basis of settlement.

Mr. Ware expressed the opinion that 90 per cent of the companies failed to keep an accurate account of toll accounts, and that many charges were jumped because they were not reported; in fact, he thought it practically impossible under existing conditions to keep track of such charges.

Several delegates held to the belief that switching charges should be allowed to companies making toll-line connections. Along this line, a member from Byron, Ohio, stated that it cost more to make transfers than he ever received from his proportion of the toll charge.

Mr. Ware ventured the opinion that the division he had mentioned was fair and equitable, and that companies not satisfied with this, had better sell out to the larger companies. Under certain conditions, where a connection was required frequently, he thought it might be well for the local exchange to ask the long-distance company to install a through line, but he thought it would be far better to do the work free of charge, rather than lose the benefits of long-distance connection, which, he said, will be the life of the business in time to come.

H. E. Graham, of Norwalk, Ohio, related his experience with the toll-line business. He stated that at the time his exchange was installed, they gave free service, yet the Bell Company secured the best patronage because it could give long-distance connections. His company became convinced that it must give similar connections or go out of business. The United States Company offered the service, but the stockholders of the company were very chary about making the 99-year contract demanded, since no allowance was to be made for switching charges. Better judgment prevailed, however, and the contract was closed. For several months the stockholders watched the accounts, and they were inclined to be disgusted with their bargain when they found that their returns from their proportion of the toll charges amounted to from $9 to $12 per month, while their operator was costing them $20 per month. At the annual meeting, however, the manager showed them a very creditable list of new subscribers, many of them at $2 per month and other at $1 per month, who had taken the service because of the new convenience. At last accounts, Mr. Graham stated, the company was considerably ahead of expenses on the toll receipts, and nothing more was being heard regarding switching charges.

Mr. Ed. L. Barber followed with a paper on "Telephone Development," in which he denounced the Bell combination, claiming that it had retarded the development of the telephone for years. He gave a brief outline of the growth of the independent movement, and stated that at the present time the independent companies were superior to the Bell in the number of exchanges in operation and in the number of points reached, and—in the territory between the Rocky Mountains and the Allegheny—in the number of instruments used. The apparatus used, he claimed, was superior to that of the monopoly, while in many cases he intimated that the Bell people were taking lessons in construction from the independents. He maintained that, without question, the service given to-day by the independent companies is superior to that of the monopoly. He stated that the general public is awakening to the fact that the independent companies are their friends; that they have learned that if they want the best service, the most accommodating service, they must come to the independent people, to whose efforts must be credited the fair prices that predominate and to whom belongs the credit of making the telephone what it is to-day, a blessing to all the people, everywhere.

As to statistics, he stated that at present, as nearly as he could ascertain, there are about 3000 exchanges with about one million telephones and many thousand toll lines, in operation by the independent companies. He expressed the opinion that the telephonic growth has only just begun. "Ultimately," he said, "the telephone will be in every home as a convenience and money saver, and a necessity in the ordinary affairs of man."

At the last moment, Mr. James E. Stewart, consulting engineer of the Telegraph, Telephone & Cable Company, of New York, was called away, and his paper on "Telephone Construction" was left in the hands of a substitute. The paper contained a lengthy discourse on the best methods to be pursued in constructing toll lines for both city and country use, giving information as to the best kinds of wire and poles to be used. Speaking of pole lines, Mr. Stewart believes that the best line to-day is one employing 35 ft. to 40 ft. poles with an 8-in. top, and measuring not less than 42 ins. to 43 ins. in circumference at 6 ft. from the butt, and carrying from four to ten-pin cross-arms. The poles should be second-growth chestnut; or, if chestnut is impossible, of white cedar, and butt-cut. They should be alive when cut, and free from large knots and reasonably straight; carefully shaved, and the roof painted with two good coats of lead; the gains should also be painted. The poles should be cut in winter, when the sap is down; for with the sap present, dry rot is sure to take place, and although looking strong and fair, the pole will lose its strength. If the precaution of seasoning is taken, there would be no danger of the pole rotting.

A portion of the paper was devoted to a description of the best methods to be used in building conduits. Wood conduits should be thoroughly soaked with a preservative, and the use of boards as a covering for tile conduits was advocated to prevent breakages by ignorant laborers. He advised the use of as large manholes as possible, and as near together as practical.

Following the reading of the papers, delegates from the various States were requested to meet and select a representative for the executive committee. The session then adjourned.

Wednesday afternoon the ladies attending the convention were given a tally-ho ride through the parks and boulevards with the Williams-Abbott Company as host.

Wednesday evening the visitors boarded special cars and were taken to Haltnorth's Garden where they were entertained by a special programme.

THURSDAY'S SESSION.

President Thomas opened the session by reading invitations for the next convention from Buffalo, Niagara Falls, N. Y., and Saratoga Springs, N. Y., and the matter of the next meeting place was referred to the executive committee. It is probable, however, that the meeting will be held in New York City, since it is the policy of the organization to have its sessions in some city where new independent exchanges have recently been opened—this being the case in New York.

The president's report was brief. He stated that incident to this convention the officers handled about 18,000 pieces of mail matter, including detailed statements of independent telephone properties in forty-four States and Territories, showing that the movement is covering the entire country. In the Indian Territory and Oklahoma the growth has been very large, with no Bell competition, while in all of the Southern States the development has been rapid, connections having been made to many points never before reached. Alaska has a number of plants, and the work is growing in that Territory.

Speaking of the independent development, he stated that it has been on a plan practically the reverse of that of the Bell Company; that is, the movement originated in the small towns, and the large cities were then connected up. He expressed the opinion that this was the best method, since after covering territory in surrounding towns it was much easier to secure franchises in the large cities, the former acting as feeders to the latter.

He stated that it was proposed to raise a fund to carry on the fight against the opposition and to lend assistance in securing franchises in new territory. He suggested also that the members of the advisory board and the executive board should have a compensation to enable them to carry on the work without personal sacrifice.

The roll of the delegates from the various States was called, and it was announced that the following had been chosen on the executive committee: Illinois, W. W. Toby, Danville; Indiana, L. A. Frazee, Connellsville; Iowa, W. H. Durin, Jefferson; Kentucky, W. B. Seaton, Ashland; Michigan, J. B. Ware, Grand Rapids; New York, W. S. Eckert, New York City; Ohio, E. L. Barber, Wauseon; Pennsylvania, S. E. Wayland, Wilkes-Barre; Virginia, Charles E. McClure, Richmond; West Virginia, John H. Gregg; Wisconsin, Richard Valentine, Janesville. Appointment of representatives from other States was left to the president, no responses having been made.

E. B. Fisher, of Grand Rapids, Mich., urged the necessity of becoming members of the national association. He stated that a number of new members had been obtained at this meeting, and that all should make an effort to secure new members. It was announced that the Wisconsin State Association had joined the national organization in a body.

Stanley E. Parkwell, of Owosso, Mich., expressed the opinion, which was backed by a number of other delegates, that the convention was made up of too much pleasure and not enough business. A number of important matters which should have come up for discussion were being overlooked to make room for pleasures—for example, the farmers' systems and the increasing expenditures. He stated that while he enjoyed the pleasures as much as any one, yet his company could not afford to send him several hundred miles to attend banquets, boat rides and theatres. He suggested that in the next meeting, arrangements should be made for the proper consideration of any questions that might arise.

Hon. S. P. Sheerin, of Indianapolis, secretary and treasurer of the association, then made his annual report. He stated that the organization had collected $3,270 and expended $3,261, leaving a balance in the treasury of $9. In 1899, the association had 119 active members, and including those who had joined during the convention, it now numbered 140. Election of officers followed.

There was no opposition to Judge Thomas for the presidency, and his re-election was unanimous. The other officers elected were as follows: S. P. Sheerin, Indianapolis, re-elected, secretary and treasurer; first vice-president, Col. H. C. Young, Columbia, Pa.; second vice-president, C. E. Stinson, Rochester, N. Y.; third vice-president, H. W. Teachout, Des Moines, Iowa; first assistant secretary, R. F. Johnson, Saginaw, Mich.; second assistant secretary, S. E. Wayland, Wilkes-Barre, Pa. The session then adiourned, and the balance of the day was given up to pleasure. At 2 o'clock the delegates and their friends boarded the steamer City of Erie and enjoyed a four hours' lake ride.

On Wednesday evening was the great social feature and closing event of the convention—a banquet at the Colonial Hotel, which was attended by about 60 ladies and over 300 gentlemen. The two large dining halls of the fine new hostelry were perfect wildernesses of palms and hangings. The tables were profusely decorated with potted and cut flowers while the menu consisted of the best that land and sea affords, including choice wines and cigars. Hon. Harry D. Critchfield, general counsel of the United States Telephone Company, was toastmaster, and the following toasts were responded to:

"Our Guests," F. H. Henry, Cuyahoga Telephone Company, Cleveland. "Why Are We Here?" Mr. Edwin R. Sharp, secretary and treasurer, Columbus Citizens' Telephone Company, Columbus, Ohio. "Frogs' Legs," Hon. E. B. Fisher, Citizens' Telephone Company, Grand Rapids, Mich. "Sneak Currents," Mr. R. Valentine, Janesville, Wis. "Trouble Shooting," Mr. Edwin R. Sharp, Columbus, Ohio. "The Manufacturer," Mr. T. E. Hughes, Philadelphia. "The Ladies," Mr. P. J. Fricker, Ashtabula, Ohio. "Patent Rights and People's Rights," Hon. S. P. Sheerin, Indianapolis. "Our Hosts," Mr. Charles E. McClure, Richmond, Va.

Mr. Sharp made three distinct questions out of "Why Are We Here?" by placing the emphasis on the "Why," the "We" and the "Here." In replying to the questions he first gave an outline of the benefits to be derived from the annual conventions, touching on the progress that had been made. "'We'" are here, said he, "because we are all interested in the independent movement, and because it is our duty to be here. We are 'Here' because this is the best place to which we possibly could have gone."

Hon. E. B. Fisher gave an amusing description of the numerous and rapid changes that have been made in the movement, likening them to "Frogs' Legs." He touched on a piece of telephonic history new to many, in which it was claimed that the principle of the telephone was first discovered by the transmission of the croaking of frogs over several miles of telegraph wire, the ends of the wires having been grounded in a peculiar manner. He stated that the invention had been developed, but that it had afterward been suppressed by the owners of the Bell telephone patents.

Mr. T. E. Hughes, in "The Manufacturer," advised closer relations between manufacturer and operator. He said that their interests were almost identical, but that the latter could not bring out improvements without the assistance and advice of the former.

In "Sneak Currents," Mr. Valentine gave an amusing description of some of the sneaks which the independents had to contend with, and several severe flings were aimed at the Bell managers. Among others, he mentioned the man who "works" the pay stations, and the non-subscriber who uses another man's telephone and then complains about the service.

Mr. Charles E. McClure, of Richmond, in "Our Hosts," stated that for a number of years he had been a manager for a Southern Bell company, and had attended numerous conventions in Southern cities noted for their hospitality, but in all his experience he had never been so courteously received and so well entertained as in Cleveland.

The convention came to a close at 2:30 a. m., with "Auld Lang Syne" by the orchestra and guests.

The trade visitors at the convention expressed themselves as well pleased with the results of the exhibition. Many of them closed contracts, and every one arranged a number of deals which will probably be closed up in the near future. The delegates showed the greatest interest in everything new in telephone construction, and those in charge of exhibits were kept constantly busy in explaining the most minute details. All expressed themselves as satisfied, while a number of dealers who were present, but did not have exhibits, were heard to remark that they were sorry they had not prepared samples of their lines. The arrangement of the different exhibits, each for the most part in a separate room, was particularly advantageous, since those in charge could get away from the general rush of comparatively disinterested spectators, enabling them to talk business to those who showed a sincere interest in the goods.

Electric Propulsion in Ohio Canals.

The report comes from Cleveland that the Ohio State Board of Public Works has entered into a contract with Thomas N. Fordyce to install a power plant for the electric propulsion of canal-boats between Dayton and Cincinnati. The canals between Dayton and Toledo, it is reported, will be electrically equipped within the next four years.

Mutual Inductance of Three-Phase Circuits.

BY AUG. J. BOWIE, JR.

IN considering the arrangement of wires of three-phase circuits on the poles, it is important that not only should the voltage drop in each circuit considered by itself be of such a nature that with a balanced load, the drops in each of the three phases are equal; but also that no circuit should affect any other circuit to an

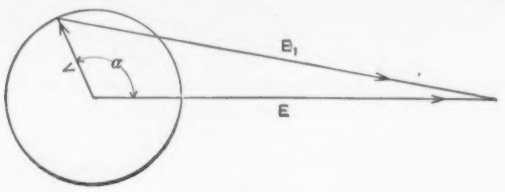


FIG. I.

appreciable extent. This effect of one circuit on another is known as mutual inductance.

It is not necessary to arrange the circuits with mathematical accuracy, so that mutual inductance is entirely overcome; but merely so that the effect is inappreciable. In other words, approximations are not only permissible, but also, in many cases, are far more rational, since they may simplify matters to a great extent. If the arrangement were theoretically perfect, no circuit should have any effect on any other circuit, whether the loads were balanced or not. However, it is usually sufficient, for all practical purposes, to consider each circuit as carrying a balanced load.

If the circuits are run from the same generators, the effect of mutual inductance will be a fixed distortion of the voltages received, under constant conditions of load. With fluctuating load in one circuit the voltages received from the other will fluctuate, too. If, on the other hand, the circuits are run from generators which run at slightly different speeds, the result will be a periodic fluctuation of the voltages received, which will cause regular pulsations, or flickering of the lights, which will be very objectionable if the effect is of any intensity. Thus in Fig. 1 let E be the voltage impressed on any phase of one circuit, and let V be the voltage consumed in overcoming the mutual induction. Then the voltage received from this circuit will be the same as if E_1 were the impressed voltage. The effect which V will have in altering E, in other words, $E - E_1$ will depend on the angle a. With a poor arrangement of the wires on the poles, V may be added to E in one phase and subtracted from it in another; thus unbalancing the voltage triangle delivered to the load. When the circuits are run from generators which are not in synchronism, a will vary periodically with the difference of speeds, and E_1 will vary between the limits of $E + V$ and $E - V$. So the voltage fluctuation will be $2V$.

The problem of the proper spiraling of three-phase lines is considerably more complicated than the corresponding problem with single-phase lines. For instance, when the three wires of a three-phase circuit are not arranged on the poles, on the vertices of an equilateral triangle; then in order that with a balanced load, the three voltages received shall be equal, it is necessary to spiral the wires on the poles. This, of course, is independent of whether or not there are other circuits on the poles. So, in this event, it is

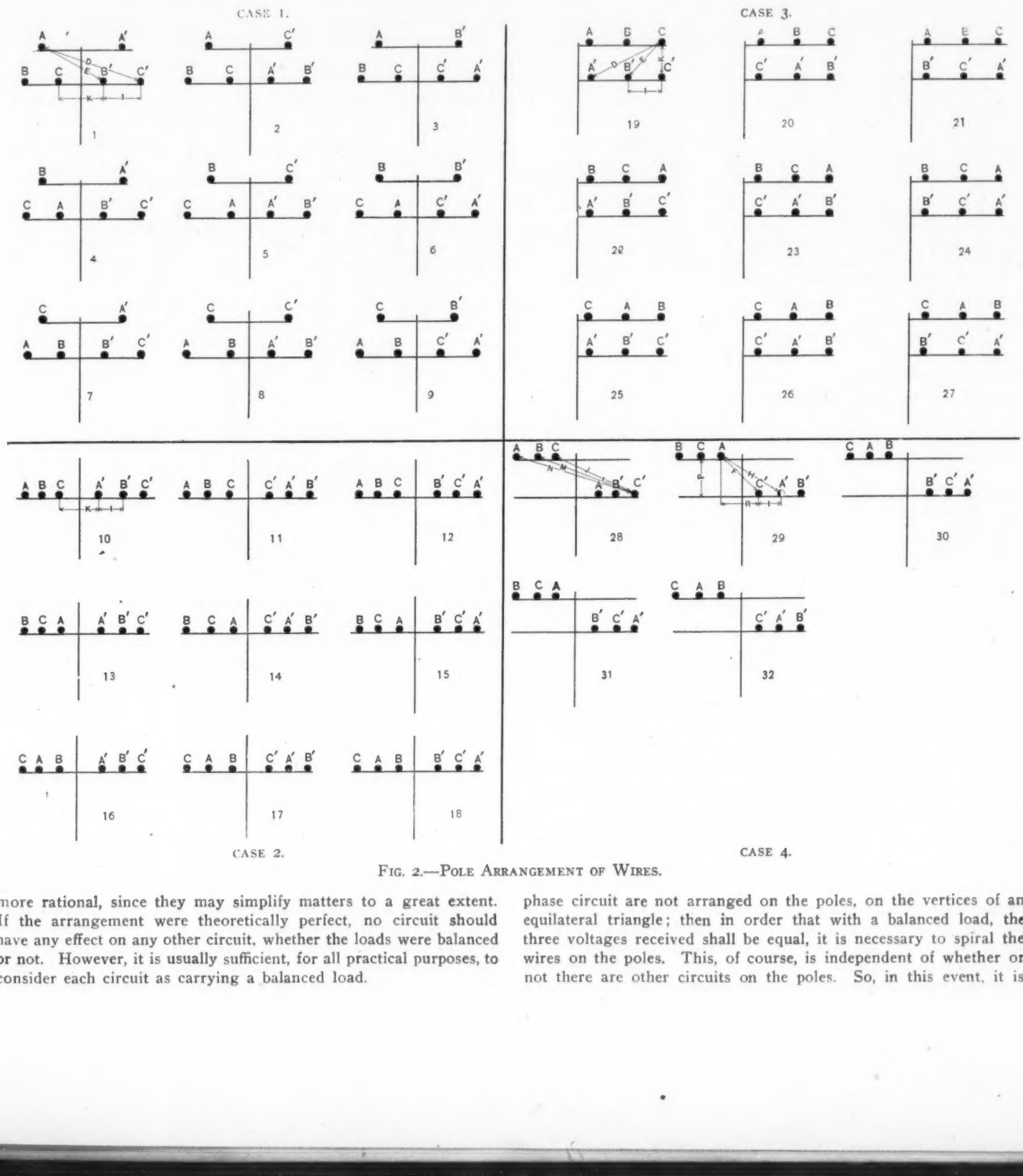


FIG. 2.—POLE ARRANGEMENT OF WIRES.

necessary to have the line make a complete spiral—in other words, to spiral it in two places—which would, of course, be absolutely unnecessary with any single-phase circuit.

Although it is common practice to arrange the wires of three-phase transmission lines on the poles, so that the three wires of each circuit are on the vertices of an equilateral triangle, still the wires can be arranged perfectly well on one cross arm, and spiraled so as to have just the same effect. In distribution lines the triangular arrangement will usually be very inconvenient—the three wires usually being placed on the same cross arm.

In all that follows, two circuits will be considered, *A B C* and *A′ B′ C′*. They may or may not run from the same generators, but the order of rotation of the phases of each will be the same.

With some of the methods of spiraling described later, the effect of mutual induction will be equal and symmetrical in all the phases, with a balanced load. In other words, an equilateral triangle of voltage delivered by one circuit will still remain equilateral, each of the phases being symmetrically affected by the mutual induction, though the voltage triangle as a whole will be altered. With other arrangements, however, and with a balanced load, while the intensity of the voltage effect on the different phases will remain the same, still the effect of mutual induction will be unsymmetrical, and the voltage triangle received will no longer be equilateral. For example, *A* will affect *A′*, *B* will affect *C′*, and *C* will affect *B′*. However, by exchanging throughout, on the poles, any two of the wires of one circuit, the effect can be made symmetrical. For instance, if *A* and *B* are exchanged, then *A* will affect *C′*, *B* will affect *A′*, and *C* will affect *B′*, which is evidently symmetrical.

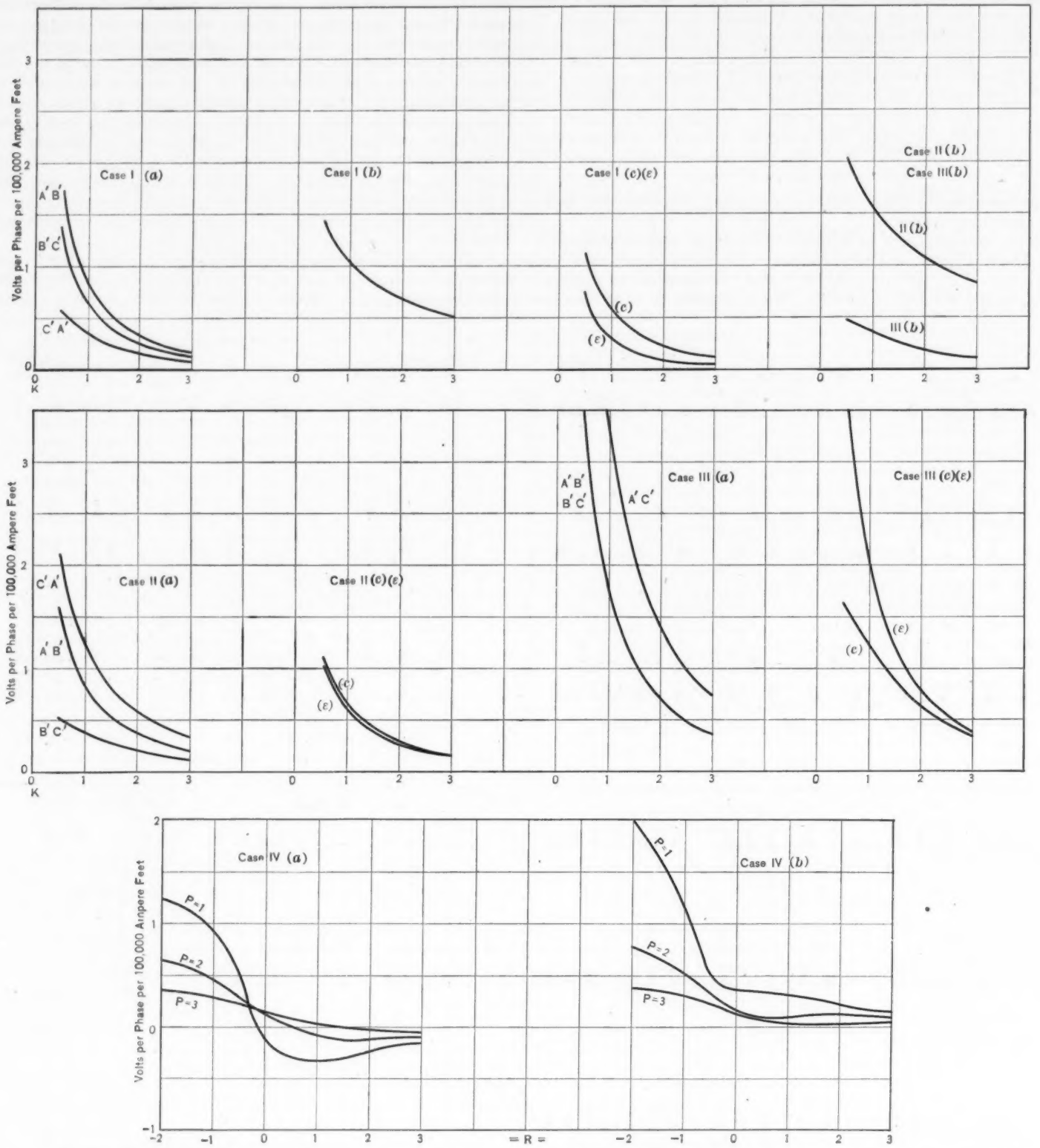


FIG. 3.—DIAGRAMS SHOWING VOLTS PER PHASE PER 100,000 AMPERE-FEET OF CIRCUIT DUE TO MUTUAL INDUCTION IN THE DIFFERENT CASES CONSIDERED.

By spiraling the wires, one complete turn on the poles is meant; for example, letting the wires run *ABC* for one-third of the distance, then *BCA* for the next third of the distance, and *CAB* for the last third of the distance. If *A'B'C'* were to run *A'B'C'*, then *B'C'A'*, and then *C'A'B'*, the spirals occurring on the same poles as in the previous case, the circuits would be said to be spiraled on the same poles and in the same direction. If *A'B'C'* were to run *A'B'C'*, then *C'A'B'*, then *B'C'A'*, the spirals occurring on the same poles as those of the other circuit, as already given, then the circuits would be said to be spiraled on the same poles, and in opposite directions. Should the spirals of one circuit be half way between those of the other circuit, instead of being on the same poles, the circuits would be said to be spiraled alternately.

In figuring the effect of mutual induction the method used is as follows: Sum up the number of lines of force passing between each wire of one circuit and a certain wire of another circuit, caused by only the currents in the first-mentioned circuit. This sum will be equal in magnitude to the inductive effect of the first circuit on the wire in question, its proper phase relation being 90° ahead of the sum. Hence the voltage consumed is 90° in phase behind this sum. In adding the effects of the different currents, of course, the vectoral, or geometrical, sum must be taken.

Calling one circuit *ABC*, and the other circuit *A'B'C'*, let the distance from *A* to *A'* be *x*; from *A* to *B'* be *y*, and from *A* to *C'* be *z*. Let *r* be the radius of each wire, and let *I*, with appropriate subscript, denote the current strength, the phase of which is supposed to be known. Let *S*, with appropriate subscript, denote the inductive effect on the wire in question, the proper phase position of which must be determined, as already indicated, remembering that *S* is the vectoral sum. Let *l* = the length of the circuit in cms, and *f* = the frequency. Then:

$$S_a = \frac{2\pi f l}{10^9}\left[I'_a(2\log_\epsilon x/r + \tfrac{1}{4}) + I'_b(2\log_\epsilon y/r + \tfrac{1}{4}) + I'_c(2\log_\epsilon z/r + \tfrac{1}{4})\right]$$

But vectoral sum $I'_a + I'_b + I'_c = 0$ ..... (1)

Hence $S_a = 4\pi f l (I'_a \log_\epsilon x + I'_b \log_\epsilon y + I'_c \log_\epsilon z) / 10^9$. (2)

Evidently *x*, *y* and *z* can be all multiplied by any quantity without changing the value of S_a. That means, of course, that the mutual induction does not depend on the absolute, but merely on the relative distance apart of the different wires in question. In other words, if the positions are given, and we multiply every distance by any fixed quantity, changing the wires accordingly, the effect of mutual induction is not altered. Hence, in any case to be considered, any one of the distances in the figure may be taken as unity—a thing which will simplify matters somewhat.

Equation (2) may be written:

$$S_a = \frac{4\pi f k L}{10^9}(I'_a \log_\epsilon x + I'_b \log_\epsilon y + I'_c \log_\epsilon z),$$ where *L*=length of the circuit in miles, and *k* = cms in a mile. But $\log_\epsilon x = \log x/\log_\epsilon$.

Hence $S_a = g L (I'_a \log x + I'_b \log y + I'_c \log z)$ ..... (3)

In this equation $g = .00467f$.

It is always possible to eliminate any one of the currents from this equation by the use of equation (1). For example:

$$S_a = g L (I'_a \log x/z + I'_b \log y/z)$$

After having obtained expressions for the effects of mutual induction on the wires of any circuit, then in order to get the effect on any phase, take the vectoral difference between the effects on the two wires of that phase. If the supposition of balanced loads be made, the problem may be solved very simply analytically. Thus if the quantity in question be $I_a \log r + I_b \log s + I_c \log t$, this can be reduced to $I_a \log r/t + I_b \log s/t$; and since I_a and I_b are equal, and 120° apart, this expression becomes

$$I\sqrt{(\log r/t)^2 + (\log s/t)^2 - (\log r/t)(\log s/t)}.$$

Should r/t, for example, be less than unity, then $\log r/t = -\log t/r$, which should be substituted in the expression under the radical.

However, if the phase position of this is desired, it would be easier to obtain it graphically.

Before starting in to put any complicated system of spirals into a system, in the hope of overcoming the mutual induction, it is surely worth while to stop to consider two things; first, whether the mutual induction is of sufficiently great importance to warrant anything of the sort, and, second, whether the system planned will accomplish what is desired. In other words, the first thing to do is to figure on the extent of the possible mutual induction. It is with this end in view, namely, to give some simple means of figuring the results in most cases met in practice, that this article is written. While some of the cases may seem somewhat complicated, yet most of them can be solved without drawing any diagrams. To obtain the apparent voltage triangle delivered to the line, the values deduced for *S* should each be laid off from the appropriate vertices of the triangle of voltages actually delivered, each being laid off in its proper phase relation. However, even there it is usually unnecessary to draw diagrams, as will be shown later.

The cases usually met in practice may be regarded as coming under the four following classes:

Case 1. Two circuits, each arranged on equal equilateral triangles, on opposite sides of the pole.

Case 2. Two circuits on the same cross arm, each arranged on opposite sides of the pole, the middle wire being equidistant from the two others of the same set.

Case 3. Two circuits, with the middle wire equidistant from the two outside wires, one circuit being directly over the other.

Case 4. Two circuits, with the middle wire of each equidistant from the two outside wires, arranged on the same, or on parallel cross arms. Cases 2 and 3 are merely special cases which come under this head.

In each of these cases the distance apart of the two nearest wires of a set will be taken as unity. This has been shown to be allowable, so long as the relative distances are not changed.

CASE 1. (See Fig. 2).

Let $B'C = K$; $A'B = D$; $A'C = E$. Then $AA' = BB' = CC' = I + K$; $BC' = 2 + K$; $AC' = D$; $AB' = E$; *D* and *E* being known, when *K* is known.

Case 1 (a). No spirals in the lines. (1.)

By equation (3): $S'_a = g L [I_a \log (I + K) + I_b \log D + I_c \log E]$

$S'_b = g L [I_a \log E + I_b \log (I + K) + I_c \log K]$

$S'_c = g L [I_a \log D + I_b \log (2 + K) + I_c \log (I + K)]$

After finding the vector sums, S'_a, S'_b, S'_c, each should be laid off in its proper phase relation (i. e., 90° behind) from the appropriate vertex of the triangle of voltages, *A'B'C'*, which is impressed on the line. Joining the three points thus found, gives the apparent voltage triangle, impressed from which the voltages received can be calculated for the line just as if there were no mutual induction. Should the value of the mutual induction on any phase be desired, this can be found analytically, as already shown.

Case 1 (b). One circuit spiraled one complete turn while the other runs straight. (1, 2 and 3.) Obviously, the circuit which is spiraled has not effect on the other circuit. However, each leg of the spiraled circuit is affected by the other circuit, but all equally and in the same direction; hence there is no distortion of the triangle of voltages received, but the whole triangle is shifted bodily relatively to the triangle which would be received, were the unspiraled line away. The extent of such shifting is by Eq. (3) $g L [I_a \log ED + I_b \log (2 + K) D + I_c \log EK] / 3 = g L [I_b \log (2 + K) / E + I_c \log K/D] / 3$.

Provided the neutral of the spiraled set of lines is grounded at both ends, the effect of mutual inductance will be to shift the position of the three legs relatively to the neutral in the voltage triangle received, although it does not affect the absolute values of the voltages between legs.

Case 1 (c). Both circuits spiraled at the same poles and in opposite directions. One complete spiral in each line. (1, 5 and 9.) By the use of Eq. (3) the following values are derived:

$S'_a = g L [I_a \log (I + K)(2 + K) K + I_b \log D (I + K) E + I_c \log ED (I + K)] / 3 = (g L I_a / 3) \log K (2 + K) / E D.$

$S'_b = g L [I_a \log E D (I + K) + I_b \log (I + K) ED + I_c \log K (I + K) (2 + K)] / 3 = (g L I_c / 3) \log K (2 + K) / E D$

Similarly $S'_c = (g L / 3) I_b \log K (2 + K) E D.$

Let $(g L / 3) \log K (2 + K) / E D = h.$

It can similarly be known that $S_a = h I'_a$; $S_b = h I'_c$; $S_c = h I'_b$. Evidently, if the phases have the same order of rotation at the generators, the result of this pole arrangement will be to cause an unsymmetrical distortion of the voltages received. However, if *B* and *C*, or *B'* and *C'* change places throughout, the result will be that $S_a = h I'_a$; $S_b = h I'_b$; $S_c = h I'_c$, and similarly $S'_a = h I_a$; $S'_b = h I_b$; $S'_c = h I_c$. With a balanced load, the effect of either circuit on the other is to give a symmetrical distortion of the voltage triangle, in the case last considered. In other words, if the triangle is equilateral, it will remain so, but will have the voltages equally affected by mutual induction.

Case 1 (d). Same as Case 1 (c) except that spirals occur alternately

on the lines instead of on the same poles. (1, 2, 5, 6, 9 and 7.) In this case it can similarly be shown that the effect of mutual induction can be made just half of its value in the preceding case, and

$S'_a = -\frac{h}{2} I_b$; $S'_b = -\frac{h}{2} I_a$; $S'_c = -\frac{h}{2} I_c$. So the phase is shifted as well.

Case 1 (e). Lines spiraled one complete turn in the same direction, spirals occurring at the same poles. (1, 6 and 8.) By the use of Eq. (3) the following values are derived:

$S'_a = g\,L\,[I_a \log (I + K)^3 + I_b \log D^3 K + I_c \log E^3 (2 + K)]\,/3.$
$S'_b = g\,L\,[I_a \log E^3 (2 + K) + I_b \log (I + K)^3 + I_c \log D^3 K)].\,/3.$
$S'_c = g\,L\,[I_a \log D^3 K + I_b \log (2 + K)\,E^3 + I_c \log (I + K)^3]\,/3.$

Evidently this gives a symmetrical distortion of all the phases for a balanced load.

Case 1 (f). Same as Case 1 (e) except that spirals occur alternately on the lines instead of on the same poles. (1, 3, 6, 5, 8 and 7.) In this case it can similarly be shown that the effect of mutual induction will be just half of its value in the preceding case, though the phase is shifted.

Case 1 (g). One circuit spiraled one complete turn while the other is spiraled three complete turns, the spirals being in any direction. (1 to 9.) Here it is evident that the effect of mutual induction will be absolutely zero.

CASE 2.

Let the distance between the two nearest wires of the different circuits be K.

Case 2 (a). No spirals in the lines. (10.) By Eq. (3):

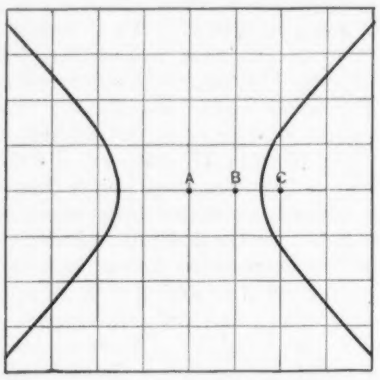


Fig. 4.—Locus of Position of Left-Hand Wire of Circuit $A'B'C'$, Case IV. (a) When Mutual Induction $= O$.

$S'_a = g\,L\,[I_a \log (2 + K) + I_b \log (1 + K) + I_c \log K].$
$S'_b = g\,L\,[I_a \log (3 + K) + I_b \log (2 + K) + I_c \log (I + K)].$
$S'_c = g\,L\,[I_a \log (4 + K) + I_b \log (3 + K) + I_c \log (2 + K)].$

This of course is unsymmetrical.

Case 2 (b). One circuit spiraled one complete turn while the other runs straight. (10, 11 and 12.) The mutual inductance is zero, but each leg of the spiral circuit has its voltage shifted equally in the same direction by an amount

$S' = g\,L\,[I_a \log (3 + K)(4 + K) + I_b \log (I + K)(3 + K) + I_c \log K (I + K)]\,/3.$
$= g\,L\,[I_a \log (4 + K)\,/\,(I + K) + I_c \log K\,/\,(3 + K)]\,/3.$

Case 2 (c). Wires spiraled one complete turn at the same poles and in the opposite direction. (See Figs. 10, 14 and 18). By the use of Eq. (3):

$S'_a = g\,L\,[I_a \log (2 + K)(I + K)(3 + K) + I_b \log (I + K)(3 + K)(2 + K)$
$+ I_c \log K (2 + K)(4 + K)]\,/3 = \frac{g\,L\,I_c}{3} \log K (4 + K)/(I + K)(3 + K).$

Let $\frac{g\,L}{3} \log K (4 + K)\,/\,(I + K)(3 + K) = M.$

Then $S_a' = M\,I_c$; $S'_b = M\,I_b$; $S'_c = M\,I_a$. This gives an unsymmetrical distortion of the voltages received. By interchanging A and C, or A' and C' throughout, the effects of mutual induction may be made symmetrical, and $S_a' = M\,I_a$; $S_b' = M\,I_b$; $S_c' = M\,I_c$.

Case 2 (d). Same as preceding case, except that spirals occur alternately instead of on the same poles. (See Figs. 10, 11, 14, 15, 18 and 16). In this case it can similarly be shown that the value of the mutual induction will be half of its value in the preceding case, though the phase is shifted.

Case 2 (e). Wires spiraled one complete turn at the same poles and in the same direction. (10, 15 and 17.) By Eq. (3):

$S'_a = g\,L\,[I_a \log (2 + K)^3 + I_b \log (I + K)^3 (4 + K) + I_c \log K (3 + K)^3]/3$
$S'_b = g\,L\,[I_a \log K (3 + K)^3 + I_b \log (2 + K)^3 + I_c \log (I + K)^3 (4 + K)]/3$
$S'_c = g\,L\,[I_a \log (I + K)^3 (4 + K) + I_b \log K (3 + K)^3 + I_c \log (2 + K)^3]/3$

This has a symmetrical effect on the different phases, for a balanced load.

Case 2 (f). Same as preceding case, except that the spirals occur alternately instead of on the same poles. (10, 12, 15, 14, 17 and 16.) In this case it can similarly be shown that the value of the mutual induction will be half of its value in the preceding case, though the phase is shifted.

Case 2 (g). One circuit spiraled one complete turn while the other is spiraled three complete turns, the spirals being in either direction. (10 to 18.) Here evidently the effect of mutual induction will be absolutely zero.

CASE 3.

Let the vertical distance between the two circuits be represented by K. Let the distance $AB' = B'C = E$, and let the distance $AC' = D$.

Case 3 (a). No spirals in the line. (19.)

By Eq. (3): $S'_a = g\,L\,(I_a \log K + I_b \log E + I_c \log D)$
$S'_b = g\,L\,(I_a \log E + I_b \log K + I_c \log E)$
$S'_c = g\,L\,(I_a \log D + I_b \log E + I_c \log K)$

Which is unsymmetrical.

Case 3 (b). One circuit spiraled one complete turn while the other runs straight. (19, 20 and 21.) The mutual induction is zero. But each leg of the spiraled circuit has its potential shifting equally and in the same direction by an amount

$$S = \frac{g\,L}{3}(I_a \log D + I_b \log E + I_c \log D) = \frac{g\,L}{3} I_b \log E/D.$$

Case 3 (c). Wires spiraled on the same poles one complete spiral in opposite directions. (19, 23 and 27.) By Eq. (3):

$S'_a = g\,L\,[I_a \log K E^3 + I_b \log K E^3 + I_c \log K D^3]/3$
$= g\,L\,I_c\,(\log D^3/E^3)/3.$

Let $g\,L\,(\log D^3/E^3)\,/3 = M$. Then $S'_a = M\,I_c$; $S'_b = M\,I_b$; $S'_c = M\,I_a$.

This gives an unsymmetrical effect, but by exchanging A and C, or A' and C' throughout, evidently the effect of mutual induction will be symmetrical, with balanced loads.

Case 3 (d). Same as preceding, except that spirals occur alternately instead of on the same poles. (19, 20, 23, 24, 27 and 25.) Here

$S'_a = -M\,I_a/2$; $S'_b = -M\,I_c/2$; $S'_c = -M\,I_b/2$.

Case 3 (e). Wires spiraled on the same poles one complete spiral in the same direction. (19, 24 and 26.) By Eq. (3) it can be shown that

$S'_a = I_a\,N$; $S'_b = I_b\,N$; $S'_c = I_c\,N$, where $N = g\,L\,(\log K^3/E^3\,D)/3$.

Case 3 (f). Same as preceding, except that spirals occur alternately instead of on the same poles. (19, 21, 24, 23, 26 and 25). Here it can be shown that $S_a = -N\,I_b/2$; $S_b = -N\,I_c/2$; $S_c = -N\,I_a/2$. This is evidently a symmetrical arrangement, though shifted 60° from its phase in the preceding case.

Case 3 (g). One circuit spiraled one complete turn while the other is spiraled three complete turns, the spirals being in either direction. (19 to 27.) The effect of mutual induction will be zero in this case.

CASE 4.

Let P be the vertical distance between the arms, and R the horizontal distance between A' and C. Let $A'C = F$; $A'B = B'C = H$; $A'A = B'B = C'C = J$; $B'A = C'B = M$; $AC' = N$. When P and R are known the rest of the quantities are of course determined. (28.)

Case 4 (a). Both circuits spiraled one complete turn at the same poles and in opposite directions. (28, 29 and 30). By Eq. (3):

$S'_a = g\,L\,[I_a \log JHM + I_b \log HMJ + I_c \log FJN]/3$
$= (g\,L\,I_c \log FN/MH)/3.$ Let $g\,L\,(\log FN/MH)/3 = T$.

Then $S'_a = I_c\,T$; $S'_b = I_b\,T$; $S'_c = I_a\,T$. When $T = 0$ the circuits will be mutually non-inductive, independent of any balance of the loads. T becomes zero when Log. FN/MH becomes 0; that is, when $FN = MH$. Substituting for these quantities their values in terms of P and R, and reducing the equation gives $P^2 = R^2 + 4R + 3/2$ as the locus of the point A'. C is the origin assumed. This is the equation of an hyperbola, with its centre at the point A. Hence provided the circuit $A'B'C'$ starts with the left-hand wire on this

locus, and is spiraled one complete turn in the opposite direction to the spiral in the other circuit, then neither circuit will affect the other. This of course is independent of the rotation of the phases in either circuit.

Case 4 (b). Lines spiraled one complete turn in the same direction, spirals occurring at the same poles. (28, 31 and 32.) By Eq. (3): $S'_a = g\,L\,[I_a \log J^3 + I_b \log H^3 N + I_c \log F M^3]/3$. Similar expression can be obtained for S'_b, and S'_c, and this will give a symmetrical distortion of voltages for a balanced load.

Where spirals occur alternately, instead of on the same poles, this case is similar to the cases already considered. The conclusions may be summed up as follows:

In all cases where one circuit is spiraled one complete turn, while the other is spiraled three complete turns, the mutual induction will be zero. Provided one circuit runs through without spirals, and the other is spiraled one complete turn, mutual induction will have no effect except to displace the absolute potential of the spiraled circuit at the receiving end of the line, though not altering the actual voltages between legs of either circuit. This is entirely independent of any balance of the loads. In all the other cases considered, mutual induction will not in general be zero, but in some cases it may be made of actual benefit by reducing the self-induction of the circuit, or, rather, by acting in opposition to it, as will be shown later, though such effect will usually be small. Where each line is spiraled the same number of times, and the spirals occur on the same poles, then with a balanced load the mutual induction will be symmetrical in the cases considered under the following conditions: Where the lines are spiraled in the same direction, and one circuit starts as *ABC*, the other circuit must start on similar pins as *A'B'C'*, *B'C'A'* or *C'A'B'*; but with the lines spiraled in opposite directions, the second circuit must start as *B'A'C'*, *A'C'B'* or *C'B'A'*. In case this is not done, mutual induction will cause an unsymmetrical effect on the circuits. Provided the circuits are spiraled alternately then the mutual induction will be halved, and its phase will be shifted 60° from its previous position. Provided the circuits are spiraled in opposite directions, then one of the methods just given for starting the circuits will cause each leg of one circuit to be affected by the same lettered leg of the other circuit. This means that if the lines are run in multiple at both ends, then with a balanced load each line will carry the same current, and the effect of mutual induction will be either to add to or to subtract from the self-induction of the lines. With the circuits spiraled on the same poles, in the manner just indicated, the apparent self-induction of each wire will be increased in Cases 1 and 2; but it will be decreased in Case 3. Where the circuits are spiraled alternately, the converse is true. If the circuits are intended to be run by different generators, it is essential that the mutual induction be reduced to a negligible point, since otherwise the result will be a flickering of the lights. With balanced loads and symmetrical arrangement, it can be easily shown that the voltage due to mutual induction will be $S_a \sqrt{3}$ on each leg of the triangle. This may be taken as a true measure of the effect of mutual induction, so it is of interest to figure out the actual values of this quantity. It will be supposed that the load in each circuit is balanced, and hence that the currents are all equal, and 120° apart. Assuming the location of the wires on the poles, the value of S depends merely on the ampere miles, and is directly proportional thereto. In case the lines to be planned were transmission lines, the effect of capacity should be taken into consideration, but it is easy to arrange transmission lines so as to avoid any appreciable effect of unequal influence of capacity, though this may necessitate more spirals than would be necessary, without taking it into consideration. It is in low tension alternating systems that the most marked effects of mutual induction will naturally be found, and sometimes it is necessary to resort to a great deal of rather complicated spiraling to avoid it. However, by moving the wires of each set nearer together, and moving the different sets further apart, the mutual induction may be greatly lessened. In these cases practically as good results may be obtained by not trying to avoid the mutual induction entirely, but rather by approximating the desired end. In that manner the problem may be greatly simplified, and the results be perfectly satisfactory.

The accompanying tables and the curves plotted from them show the actual value in volts of the mutual induction on each phase per 100,000 ampere feet of circuit at a frequency of 60 cycles. For any other frequency the results should be altered proportionally. To obtain the fluctuation in voltage due to the generators not being in synchronism, the values given in the tables should be doubled. The distance apart of the two nearest wires of a set is taken as unity—all other distances being in proportion thereto. Quite a common method of spiraling transmission lines is that shown in Case 1 (*c*). However, it is evident from the tables that this by no means obviates the mutual induction, but that the value of the latter is about equal in magnitude to the average value for the three phases when neither line is spiraled; and although the actual value of the mutual induction is equal in all three phases, still the effect is unsymmetrical. By changing two of the wires of one circuit, as already indicated, the effect can be made symmetrical. By spiraling the wires in the same direction—(Case 1 (*e*))—the mutual induction is only about half of what it is in the case just mentioned. From the tables—Case 2 (*c*), (*e*)—it is evident that the mutual induction is about the same, whether the wires are spiraled in the same or in opposite directions. In Case 3 (*c*), (*e*), the mutual induction is evidently less with the circuits spiraled in opposite directions than when they are spiraled in the same direction. In Case 4 (*a*), the locus of the left-hand wire of the circuit *A'B'C'*, when the mutual inductance is zero has been plotted. In plotting the curves of Case 4 (*a*) negative values of the mutual induction are used; but this is merely because in crossing the locus just mentioned, the mutual induction changes its sign.

Where circuits are run from generators which are not run in synchronism, the problem of mutual induction is most serious. In these cases it is the absolute value of the mutual inductance that is of prime importance. However, if the circuits are run from generators running in synchronism, the phase, as well as the magnitude of the mutual inductance are both important. With unsymmetrical arrangements the voltage in one phase may be raised, and in another phase may be dropped, which is a thing to be guarded against.

Now the question may arise, that if it is possible to avoid mutual induction entirely, why should any of the methods employed in Cases 1, 2 and 3, under the heads of *c*, *d*, *e* and *f*, and in Case 4, *a* and *b*, be used. It is not necessary to use them in most places where they are in use. However, particularly where there are several circuits on a pole, by a judicious combination of these methods, the number of actual spirals put into the lines may be very much diminished, over

Tables showing the volts per phase per 100,000 ampere-feet of circuit due to mutual induction, in the cases considered.

The various values given under the heads of Cases 1 (*b*), 2 (*b*), and 3 (*b*), represent the amount by which the potential of each of the legs of the spiraled circuit is altered, due to the presence of the other circuit. As has been shown, however, this has no effect on the voltage between legs of either circuit. With the neutral of the spiraled circuit grounded at both ends, it will affect the position of the neutral in the voltage triangle.

CASE I.

	(a)					
K	*A'B'*	*B'C'*.	*C'A'*.	(*b*).	(*c*).	(*e*).
½	1.73	1.36	.56	1.44	1.12	.71
1	.82	.64	.35	1.03	.57	.28
1½	.48	.38	.22	.81	.35	.15
2	.31	.25	.16	.67	.23	.09
3	.16	.14	.09	.50	.13	.05

CASE II.

½	1.59	.52	2.09	2.05	1.12	1.08
1	.83	.37	1.20	1.54	.62	.61
1½	.52	.28	.80	1.26	.42	.40
2	.37	.21	.58	1.07	.30	.29
3	.21	.13	.35	.83	.18	.18

CASE III.

½	3.51	3.51	5.66	.47	1.63	4.02
1	1.74	1.74	3.21	.35	1.22	2.00
1½	1.04	1.04	2.04	.25	.87	1.17
2	.70	.70	1.39	.18	.63	.76
3	.37	.37	.73	.10	.35	.38

CASE IV.

	(a)			(b)		
R	*P* = 1	*P* = 2	*P* = 3	*P* = 1	*P* = 2	*P* = 3
—2	1.22	.63	.35	2.00	.76	.38
—1	.92	.47	.29	1.15	.54	.31
0	—.11	.14	.15	.36	.19	.16
1	—.33	—.06	.03	.33	.10	.05
2	—.22	—.11	—.03	.23	.12	.04
3	—.15	—.10	—.05	.15	.10	.05

what would be necessary, were the arrangement mutually non-inductive. It is very undesirable to cut up the lines to any extent, and the more spiraling can be avoided the simpler and better will the system be.

The writer is not aware of any place where the system is used of spiraling the lines alternately, instead of on the same poles; but the advantage of the former over the latter method is at once apparent, since with only a single additional spiral on one of the lines, no matter how many complete spirals are put into the lines, the mutual induction is only half of what it would be in the latter case.

A New Synchronizing Device for Rotary Converters.

BY F. W. SPRINGER.

IT is well known to those familiar with modern alternate-current transmission of power that the generators of the primary alternating current are usually and preferably run in parallel, so that the battery thus constituted delivers its power as a single unit.

In electric railways, and other systems in which motors are to be driven, rotary converters are connected in circuit with the alternating-current system so that direct current may be delivered to the motors. The common and most feasible way of starting a converter has been to connect it and speed it up as a direct-current shunt motor, and then to connect it into the alternating-current circuit by closing the proper switches at the very instant it is running in synchronism with the primary generators.

Successful synchronizing on the above plan depends partly upon the conditions of the system and partly upon the skill of the operator. When either are unfavorable, disastrous results are very liable to follow.

The switch or switches, for connecting the rotary converter in the alternating circuit, may be closed in several different ways; but for

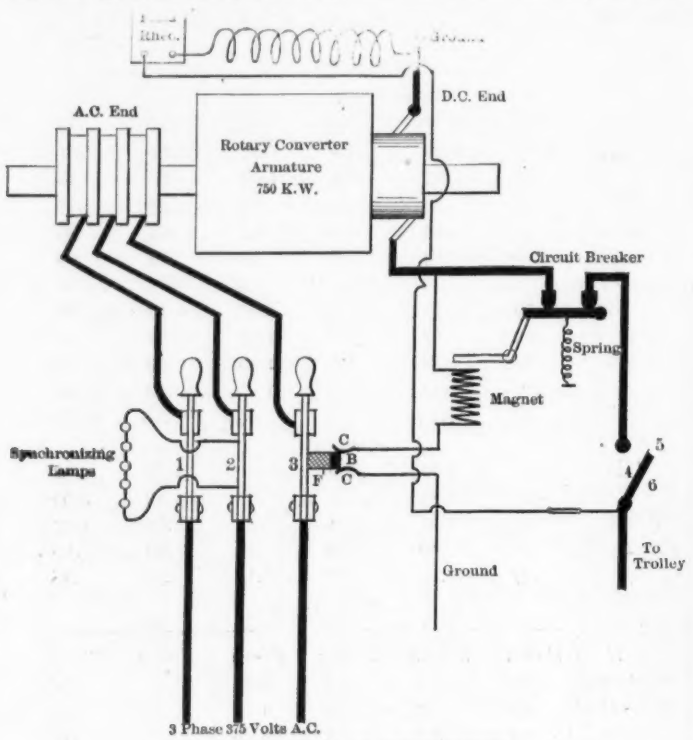


FIG. 1.—DIAGRAM OF CONNECTIONS.

convenience and rapidity it has been found most desirable to close the switches at the very instant that the converter is brought into synchronism and while it is under direct-current control. This is also the most dangerous way. With generators running in parallel, the rotary converter being small in comparison, it has been found more consistent with safety to cut out the rotary converter from the direct current at the very instant it is connected to the alternating circuit. This action, when successfully carried out, is, from all points of view, the most approved manner of putting the rotary converter under the control of the main alternating current.

Heretofore, the above manipulation of the switches for closing and opening the circuits has been performed by hand; that is, independent hand actions have been required, one to open the main circuit breaker in the direct-current circuit, and the other to close the alternating current switches. These independent hand actions are subject to the danger of cutting the direct current off too soon or too late. If the direct current be cut off after the alternating-current switches have been thrown in, that is, if the direct current be cut out too late, vicious sparking will occur, and other rotary converters of the system will be liable to be kicked out of step. If the direct current be cut off too soon, the rotary will drop below the synchronizing speed, and if thrown in at that time is liable to shut down the whole system.

The new device automatically opens the direct-current circuit at the instant of closing the alternating-current switches, and is so

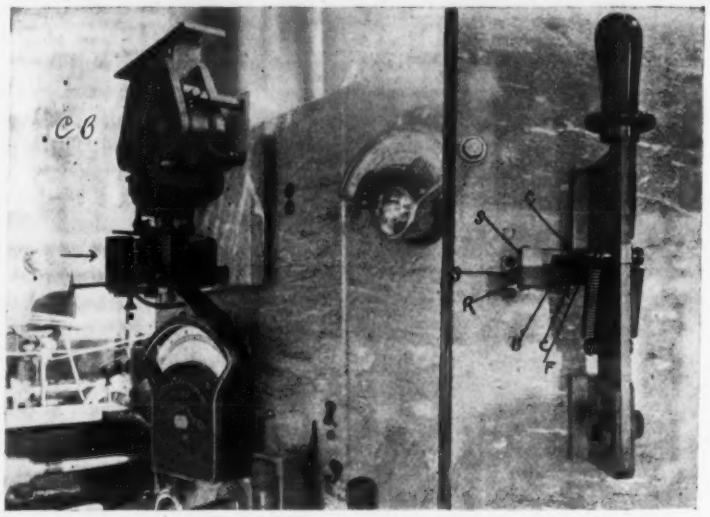


FIG. 2.—MAGNET COIL. FIG. 3.—SWITCH.

timed that no trouble can occur from a conflict of alternating and direct-current effects on the rotary. It will be readily understood by a brief description of its operation and reference to the accompanying figures.

Suppose the rotary converter to be standing still, referring to Fig. 1, the procedure would be as follows:

(1st) Close the switch in the field circuit of the rotary; (2d) by means of an adjustable rheostat, connected across the terminals 5 and 6 of the direct-current side of the rotary, the armature may be brought up to speed and switch 4 closed; (3d) adjust the shunt-field rheostat,

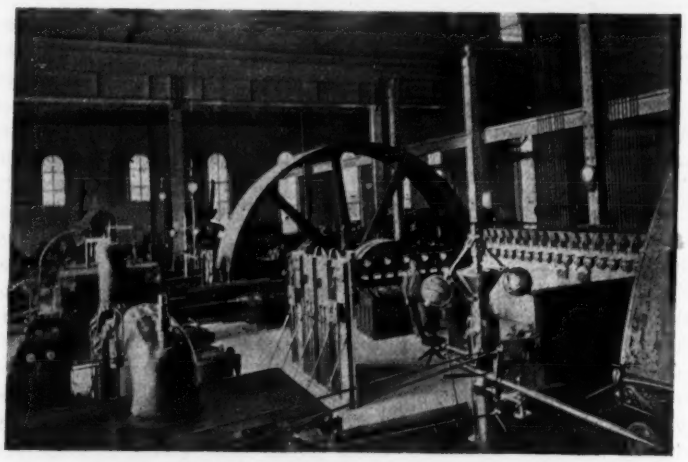


FIG. 4.—VIEW OF INTERIOR OF POWER HOUSE.

shown in Fig. 1, until the synchronizing lamps indicate that the rotary is in step; (4th) having already thrown in the alternating switch 1, at the instant of synchronism throw in switches 2 and 3 simultaneously. During the closing of switch 3, the metal plate *B* makes electrical connection between clips *C* and *C*, completing the circuit through the magnet. The magnet being energized, actuates the trip of the circuit breaker, and thus opens the direct-current circuit. Plate *B* is in contact with clips *C* and *C* while switch 3 is being closed; when the latter is completely closed *B* is carried past the clips, and the magnet-circuit again opened; (5th) the adjustable rheostat should now be removed from contacts 5 and 6, and switch 4 opened; (6th) close the circuit breaker, adjust the field rheostat, if necessary, and finally close switch 4.

Fig. 2 shows the magnet coil as applied to a General Electric circuit breaker. In Fig. 3, "*F*" is a fibre lug permanently fixed to the switch

blade; *"B"* is a metal cap placed on the fibre lug so as to come in contact with the brass clips, *"C.C.,"* not shown very clearly in the photograph; *"S.S."* is a hollow brass standard to which are attached the clips. The upper clip is insulated from the standard by the rubber block *"R,"* and is connected to the ground by an insulated wire passing through the standard. The connection to the other clip is made at the back of the board on the standard itself.

The above invention was made by Mr. John Pearson, operator in power house No. 1 of the Twin City Rapid Transit Company, Minneapolis, Minn., and has been in daily use at the latter place for over a year. It is now in use in all power houses owned by the above company. A patent on the device has been applied for, and all claims covering essential points granted.

Fig. 4 is a very good picture of power house No. 1. Arrows indicate the position of the alternating-current switchboard and the two 750-kw rotaries, respectively. The station was originally the main street railway power house in Minneapolis, and is equipped with two 1500-hp triple-expansion, condensing Corliss engines and 175-kw Edison 500-volt generators. The plant is now used as a sub-station and the steam equipment held as a reserve.

The Paris Exposition.

PALACE OF MECHANICS.

The difference between the huge Machinery Hall of the Paris Exposition of 1889 and the present modest section of the show of 1900, to which the same name has been applied, is most striking, but it arises entirely from the plan adopted and upon which the whole scheme of the current exposition is based. In 1889, all the machinery was practically put under the one huge roof, and for purposes of study and comparison that was in many ways an excellent plan, for all machines are more or less kindred and have a relationship of motive power, movement or function. But this year, machinery is scattered everywhere, the idea being to show processes, raw products, etc., close to the space where the finished article is exhibited. In 1889, steam was the chief power for driving all this machinery, so that the apparatus of whatever character had to be concentrated at the one spot, but now, with nearly 500 large electric-power motors hitched to the machines, tools and other appliances, it is a well-nigh endless task not alone to see the various apparatus that is moving in the different groups, but to form some kind of clear, comprehensive conception of the result attained as a whole. The ability of electricity to run a machine anywhere, everywhere, and under all conditions of environment is brilliantly displayed, but as an offset there is confusion in the public mind as to what really constitutes the mechanical and the electrical exhibit proper. In short, the whole Exposition is thus more or less mechanical and electrical except the departments of fine arts, and it is hard to escape from the hum of the motor by day or the lights of the arcs and incandescents by night.

FIG. 2.—CHATEAU D'EAU IN PLAY.

Still there is a Palace of Mechanics, and it occupies the last of the three divisions of the one large building on the left of the Champ de Mars, looking toward the Chateau d'Eau, being the nearest to it on the one side, as the Palace of Chemical Industry is on the other, both of them merging into Electricity Building. This is a good grouping, but it would have been much better had the mechanical exhibit been representative. It is now well known that nearly all the Machanics

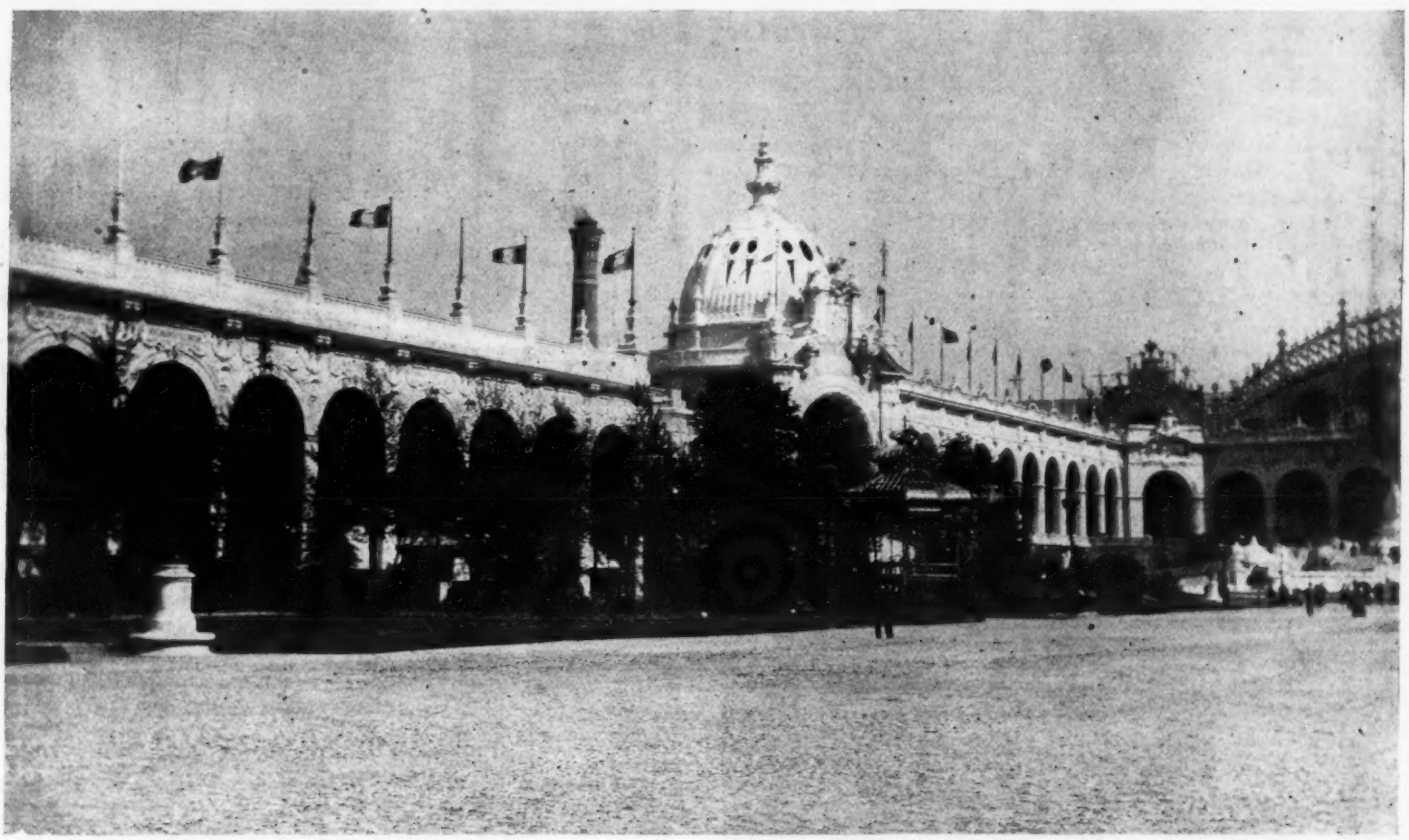


FIG. 1.—MACHINERY AND MECHANICS BUILDING, AND PART OF ELECTRICITY BUILDING. CHAMP DE MARS.

classes, except the French exhibits in them, have been banished to Vincennes, America alone occupying one large building itself there and several annexes, so that the visitor to the Palace of Mechanics

FIG. 3.—CHATEAU D'EAU, TAKEN FROM EIFFEL TOWER.

must content himself chiefly with an inspection of French machine tools, pulleys, etc. Just outside the Palace, on the façade toward the Avenue de la Bourdonnais, the gas industry has a large area, inclusive of engines of the Otto and other types, while apparatus for fire extinction is also to be found there. Just beyond the Palace of Mechanics, towards the Eiffel Tower, is the Palace of Fabrics, Clothing, etc., embracing a large number of classes in which machinery is

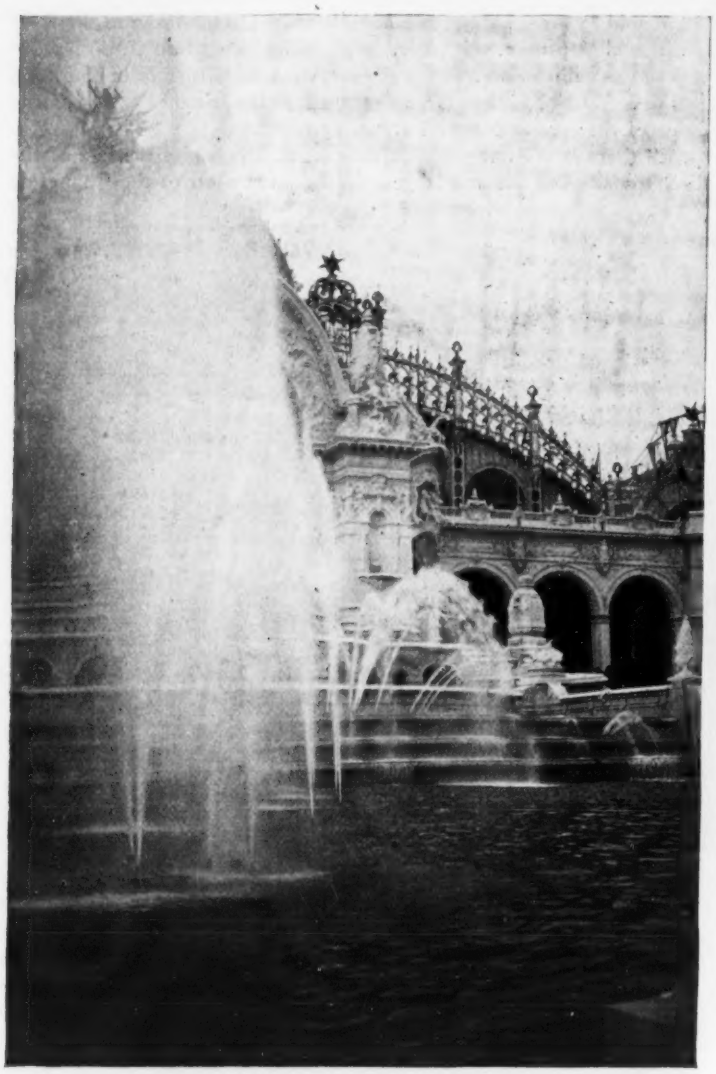


FIG. 4.—JETS PLAYING ABOVE HÓLOPHOTE BOXES; LOWEST BASIN CHATEAU D'EAU.

shown; and that Palace again merges into that of Mines and Metallurgy, where tools and machines cut a prominent figure. In spite of the general plan adopted of associating materials and processes in every class, there is therefore a more marked concentration of machinery in and around the Palace of Mechanics than anywhere else in the Exposition. Electricity Building, across its end, marks a limit in one sense, but it would be impossible for any one to tell where the one set of exhibits ends and the other begins, either on the ground floor or in the galleries. Indeed, not a little of the space in Mechanics is occupied by French electrical apparatus in the shape of dynamos and motors, while in some parts of Electricity Building there are whole blocks of machines and apparatus, machine tools, etc., which might be run by electricity, but never could be made to generate it. Group 4 of the official classification includes Class 19, steam engines, etc.; Class 20, various motors; Class 21, general mechanical apparatus, and Class 22, machine tools.

The exterior of the Palace of Mechanics is quite simple in its ornamentation, the front being without the large relief tablets such as characterize the Transportation Building across the Champ de Mars. It has a ground floor exterior corridor of great width for restaurants, and an upper exterior gallery brightly frescoed, and both are illuminated by lines of arc lamps. All along the edge of the building, and

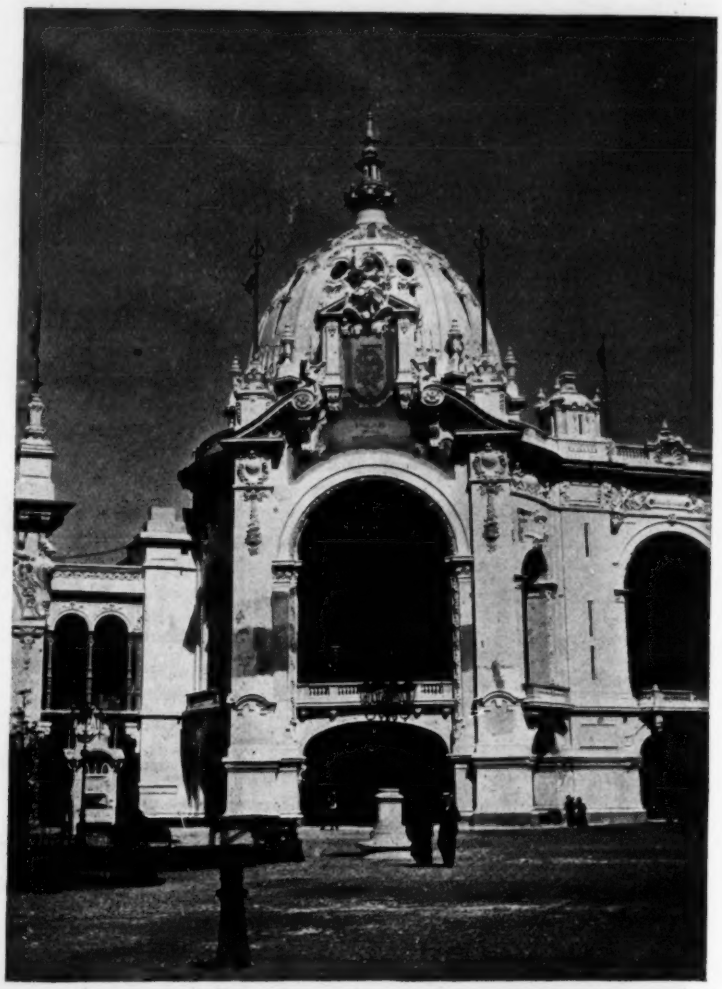


FIG. 5.—PORTICO OF MECHANICS BUILDING, CHAMP DE MARS.

partially concealed within the cornice so as to shed a reflected light downward, are incandescent lamps, this treatment of the façade being repeated also in the Chemistry Building opposite. The other Palaces on the Champ de Mars are outlined with gas jets, but a softer, steadier illumination was necessary around the luminous fountains of the Chateau d'Eau. The gallery of the Palace of Mechanics is one of the favorite places from which to witness the illumination of the Chateau d'Eau and Electricity Building, as its balconies look right out on the scene from a good height over the heads of the vast crowd.

Northwestern Convention.

In addition to the list of papers to be read at the Waupaca convention of the Northwestern Association, recently printed in these columns, there will be a paper on street lighting by Mr. H. H. Wait, of Chicago. All arrangements have been completed with the various passenger associations for a one and one-third fare for the convention round trip.

CURRENT NEWS AND NOTES.

THE HAWAIIAN SUBMARINE CABLE.—The United States despatch boat Iroquois recently sailed from Honolulu, H. I., to make soundings and to determine the route for laying the new government cable to Honolulu.

THE UNIVERSITY OF CALIFORNIA graduated a class of sixteen young men in electrical engineering this year. James D. Mortimer, a member of that class, was medalist. Professor C. L. Cory had the direction of the electrical studies.

THE SOCIETY OF THE HEBREW TECHNICAL INSTITUTE will give an exhibition on the afternoon of June 20, at which samples of work of the students during the past year will be shown. In the evening of the same day, graduating exercises will take place.

JUNGFRAU RAILWAY.—In the article on the Jungfrau Railway, which appeared in the issue of May 12, mention was omitted that the locomotive carriages were supplied by the Schweizerische Lokomotiv and Maschenenfabrik, of Winterthur. Two of the photographs on page 695 show the parts built by this company, which has supplied many of the electric railways of Switzerland.

COMMENCEMENT AT THE UNIVERSITY OF ILLINOIS.—Among the graduates of the University of Illinois, who received their diplomas June 13, are eight in electrical engineering. Of these, three handed in theses on tests of a 7½-kw synchronous converter; two on the study of the transformer magnetic current; one on the design of a 40-kw induction generator, and one on the design, construction and test of a rectifier. Mr. Wm. Fdk. Schultz received the degree of electrical engineer, his thesis consisting of a theoretical and experimental investigation of induction machines.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—The eighth annual meeting of the Society for the Promotion of Engineering Education will be held at New York, July 23 and 24, 1900, at which 15 papers will be read, and the reports of several committees presented. Among the papers are the following: "Business Methods in Teaching Engineering," by Prof. A. L. Rice; "The Relation of the Technical School and the Manufacturer," by Walter B. Snow; "Operating Work as a Feature of Electrical Laboratory Training," by Prof. W. S. Aldrich; "Secondary Technical Education in Mechanical and Electrical Lines," by Prof. A. L. Williston.

GERMAN AUTOMOBILE EXHIBITION.—A permanent automobile exhibition has been opened in Berlin, the exhibition comprising motor cars and motor-driven vehicles of every kind for conveying passengers and for the transport of goods; motor cycles and tenders; accessories and fittings for motor cars, as well as outfits, tools, drawings, models, etc. The building is in a central location near the Friedrichstrasse railroad station, and gives 12,000 square feet of space; in addition, there are a number of courts that partly open on the street. The company is composed, to quote from the circular, "of leading men of the financial and the industrial world, and members of the aristocracy." The manager of the exhibition is Mr. G. Freund, who successfully managed the technical part of the 1899 "International Motor Car Exhibition" in Berlin. Information in detail may be procured by addressing Automobile-Ausstellung, G. m. b. H., Dorotheen Strasse 6, Berlin, N. W.

BIDWELL AGAIN.—Benson Bidwell has sued the Indianapolis Street Railway Company, in the United States Court, alleging infringement of patent, and demanding $50,000 damages. Bidwell claims to be the inventor and patentee of trolley appliances which have been used by street railway companies all over the United States without compensating him. This suit is primarily for back royalties for the use, as he claims, of his lighting patent. Bidwell claims that his patents cover every device used on the trolley car except the car and motor. He asks the court to decree that he is the original inventor of the system of propelling, lighting and heating cars by electricity, and that the local company is infringing on his rights. He asks that an accounting be taken of the company's profits, and that he receive damages accordingly. Bidwell proposes to bring similar suits throughout the country.

ELECTRIC MEASURING INSTRUMENT.—A patent issued July 12 to E. C. Rimington, London, England, describes an improvement in instruments for measuring electrical current or pressure, which has for its object the construction of an exceptionally cheap and simple instrument which dispenses entirely with frictional resistance, and which will enable the instrument to be used in either a vertical or horizontal position, and not be sensibly affected by slight divergences from the position in which it was calibrated. A soft iron core is attached to a spring of steel or phosphor bronze, or other resilient metal; one end of the spring is permanently clamped in position and the other end acts as a pointer for the indicating dial. The current to be measured passes through a coil, which attracts the soft iron core above mentioned, and the attractive force causes the end of the spring to move along the dial, and thus indicate the current or voltage to which the instrument is subjected.

ELECTRIC ARC LAMP.—A patent was issued June 12 to Emile Bonhivers, of Levallois-Perret, France, relating to the new refractory composition intended for the manufacture of disks applicable to arc lamps for the purpose of increasing their illuminating power. The block is so arranged as to be immediately above the arc and becomes heated to a high temperature, it being incombustible, and becomes incandescent without deterioration. The material of which the block is made consists of 25 parts of raw clay, 50 parts of baked clay, 20 parts of pulverized quartz and 5 parts of boric acid. After mixing, the material is moulded and subjected during 48 hours to a temperature in a furnace reaching from 1500 to 2000 degs. C. After being thus baked, both the mould and the composition contained therein are thrown into a concentrated solution of boric acid, after which the block is taken out of the mould and dried. For an arc lamp the block is of plano-concave shape with a hole in the centre through which the carbon passes.

ELECTRICAL TREATMENT OF ORES OF NICKEL, ETC.—A patent granted June 12, to Henry Leleux, of Paris, France, describes a method for electrically treating nickel, cobalt, silver, lead and copper ores, whereby, it is claimed, a considerable economy is effected as compared with the present methods of treatment. Ores without preliminary roasting or fusion are placed in an electric furnace in contact with an electrode of the metal whose heat of combination with the non-metallic constituents of the ore to be liberated is higher than the heat of the metal to be liberated; the current is passed through the electrodes and ores, and acts only as a source of heat for bringing the ore to such a temperature as to cause the suitably chosen metal of one of the electrodes to unite by exothermic reaction with the metals that are associated with the particular metal to be liberated. One of the electrodes forms the hearth of the electric furnace, and may be the same as the metal which is to be produced, or may be of carbon. In the case of nickel, the hearth is faced with nickel. The upper or movable electrode consists of iron.

ELECTRICAL WELDING.—In the ordinary method of electrical welding the two pieces are brought in contact with each other; the heated current is passed through them until the temperature has rendered the metal extremely plastic, and then the two surfaces to be welded are pushed towards each other so that the two surfaces will directly unite. In a patent granted to Richard Eyer, June 12, a process is described which may be used with the ordinary electric welding apparatus, and which differs from the process above referred to, in that the union between the two articles is not made at the original contact surfaces, in this manner defective welds being avoided which arise from an imperceptible film of oxide caused by the exposure of the surfaces to the atmosphere. In the process described, a stream of water is applied to the metal a short distance on each side of the end contacts. As the metal softens, sufficient pressure is applied to upset the plastic end metal so that the real weld between the two metals is formed between the metal which has been kept cool by the stream of water playing on it, the original contact surfaces of the bars being forced entirely outside of the regular section and the protruding metal subsequently removed.

PRODUCTION OF CHROMIUM OXIDE.—The production of chromium hydroxide by electrolysis from solutions of alkali chromates or bichromates demand certain special conditions in order to obtain a good output. For example, when a solution of alkali metal chromate is electrolyzed cold with platinum electrodes, a very considerable expenditure of energy produces only a small quantity of hydroxide. If for the platinum cathode be substituted one of mercury, and the solution maintained at a temperature of about 70 degs. or 80 degs. C., the formation of chromium oxide is at once observed and the action goes on quickly, being favored by the nature of the cathode and by the circulation of the liquid due to its temperature and the evolution of bubbles on the surface of the mercury cathode. This latter process was the subject of a patent granted to E. A. G. Street, of Paris, France, the claim being for a process of manufacturing chromium hydroxide from a solution of alkali metal chromates or bichromates, consisting in passing an electric current from a suitable anode through a solution to a mercury cathode while the temperature is maintained at about 70 degs. C.

UNIV. OF PA. ENGINEERING SCHOOLS.—A directory of engineering graduates of the University of Pennsylvania has been issued, which also contains some interesting facts relating to the growth of the institution. The University of Pennsylvania was founded in 1740. Its development within the last decade may be judged partly from the following: In 1890 it had 1579 students and 180 instructors. It has now an enrollment of 2673 students and a staff of 260 instructors. Of its 34 buildings, 20 were added during the past 10 years. The buildings and equipment, exclusive of land, represent an estimated value of $4,649,592, and an actual expenditure of $3,159,947 since 1890. The courses in civil and mechanical engineering were established in 1872; those in electrical and chemical engineering in 1891 and 1892, respectively. There are at present 306 students in the Towne Scientific School, of whom 172 are pursuing courses in engineering. The graduates number 469, of whom 445 are living. Of these, about 71 per cent are engaged in engineering practice, 12 per cent in lines related to engineering, 13 per cent in other professions and pursuits, and the addresses of the remaining 4 per cent are unknown.

A SELECTOR SYSTEM OF WIRELESS TELEGRAPHY.—The London *Electrician*, in the issue just at hand, refers to a patent granted to Messrs. B. S. Cohen and P. H. Cole for a selector system for working a number of wireless telegraph stations. After various experiments in this direction the inventors patented a method of synchronizing the stations by means of falling mercury drops. The main or master stations sends out successive waves at equal intervals of time, these waves actuating an electromagnet device whereby a mercury drop is liberated simultaneously at all the stations. In its descent each drop passes a number of contacts, closing the message circuits. Thus, when a signal wave is sent out at any one station, it is received only by that station in which the receiving circuit is simultaneously closed by the falling mercury drop. To effect this, of course, the stations are connected in rotation to the contacts in the path of the mercury drops. Our contemporary adds that it trusts the inventors will carry their investigations further and develop the system on a larger and more practical scale; for whatever the difficulties may be, there can be little doubt a good selector system would be welcomed by wireless telegraphists.

STORAGE BATTERY CIRCUIT.—In a system of distribution involving the use of a storage battery and booster there is a tendency of the dynamos on an increase of load to take the whole load, the batteries on account of the drop of potential therein, taking no part of it. This difficulty has generally been overcome by using a differential series coil on the booster which at times of heavy load decreases the magnetization and hence the e. m. f. of the booster, and thus permits the battery to feed to the line. In a patent dated June 12, and granted to A. S. Hubbard, it is stated that this method is open to the objection that on increase of load there is danger of the battery being abnormally overtaxed. To overcome this objection the patentee controls the magnetization of the booster by a circuit which is in parallel with the load and including a counter e. m. f. generator which is responsive to increase to the load and decreases the booster voltage and permits the battery current to flow to the line. The field magnet of this counter e. m. f. generator is in series with the load, and the armature is mechanically connected to the power plant to be run at constant speed. The magnet, however, is so wound that on the increase of load to an excessive amount, the core becomes saturated so that the booster e. m. f. is not cut down any further, and the battery is thus safeguarded.

THE CHAMBLY WATER AND POWER COMPANY, of Montreal, is about to add very largely to the present plant at Chambly, and before another year, or eighteen months, has passed there will be developed some 30,000 electrical horse-power. The scheme is the development of an additional power at St. Therese Rapids, some three miles up the river from the present plant. In addition to this, it is proposed to develop the existing plant to its extreme limit. At the present time the Chambly works are giving some 7500 horse-power, but the contract for the construction of additional masonry has been awarded, and when this is completed and the electrical plant installed, the works will be capable of developing 20,000 horse-power. The new works, which it is proposed to erect at the St. Therese Rapids, will, when fully developed, give an additional 10,000 horse-power, making in all about 30,000 horse-power. It is expected that the addition to the old works will be completed this summer, while the new works will take eighteen months to complete. This scheme again revives the talk of business arrangements between the Royal Electric Company, the Montreal Street Railway and the Chambly Water and Power Company. That there is some deal on foot between the companies there seems no doubt, and it is expected that some announcement will be made soon.

EXPORTATIONS OF AMERICAN COAL.—The remarkable increase in coal exportations from the United States, coupled with the fact that we became in 1899 the world's largest producer of coal, gives special interest to an elaborate discussion of the world's coal product, published by the Bureau of Statistics of the Treasury Department, in the April number of the *Monthly Summary of Commerce and Finance*. Exportations of coal from the United States in the 10 months ending with April, were nearly 50 per cent larger than those of the same months of the preceding fiscal year, and 80 per cent larger than those of the corresponding months of 1898, while our total production for 1898 was not only the largest in our history, but larger than that of any other country in the world. For the first time the United States figures show a larger production than the British figures for the same period. According to recent information, steamers have been chartered to carry coal from America to St. Petersburg and Stockholm, as well as to Italian, French and German ports. While these exports may be due mainly to the present abnormal conditions of the British coal market, there is no doubt that in time this country will be called upon to supply an over larger part of the coal needed by foreign industrial countries, which, until recently, have been drawing upon the British output. This is the more probable since cost of production and prices of coal show a falling tendency for this country, whereas the opposite holds true of European coal-producing countries.

TRADE WITH MEXICO AND SPANISH AMERICA.—A Mexican correspondent of the *Iron Age* throws some light upon the causes of the failure of American bidders to secure certain contracts in Yucatan for structural iron and electrical plants, the latter to cost $500,000, and a $400,000 pier to be constructed at Progreso, Yucatan. His statements on the subject are reproduced herewith, in part, and deserve the careful consideration of all manufacturers and dealers who are looking to our southern neighbors for a market in Spanish-America. "It is claimed," he says, "that the reasons why the Germans (Siemens & Halske) and the British got the contracts was because they offered 'better deliveries, lower prices and better conditions all round.' The Mexicans also claim that the Europeans furnish more detailed specifications than their American competitors, and that they gladly prepare elaborate plans, specific prices and every bit of minute data which the native requires, because he knows little or nothing of mechanical contrivances and plants. At the same time, that in these statements we have some of the real causes for our loss of trade in this and similar cases, we must not forget several other factors, such as the closer relationship of business methods between the Mexican or Spanish-American and the European than with the American; then again, the German or English merchant has thoroughly prepared himself for years, by study in Europe, in the language of these people—Spanish; it is no mere smattering or 'short cut' method which he has employed, but he has gone at it seriously, with the conviction that it needs work and time to conquer a language which is to be a very principal tool in his future business workshop. Our American, on the other hand, brings little or no preparation of this kind, cannot therefore use his business arguments in favor of machinery and plants, which are often the wonder of the civilized world, and returns disgusted."

LETTERS TO THE EDITORS.

A Coherer Telephone Transmitter.

To the Editors of Electrical World and Engineer:

Sirs:—The following design of a telephone transmitter has occurred to me, and as I have at present no way of testing it, possibly others might care to do so if they think it worth the trouble. I would mount on a suitable sounding board a coherer and connect it in circuit with a battery and the primary of the induction coil in an ordinary telephone instrument. The ordinary cohering apparatus would be arranged with a rapid circuit breaker so that the cohering waves would strike the coherer with too great rapidity to produce an audible sound. I presume that the coherer would thus be practically in a constant state of sensitiveness. The sound waves that are to be transmitted act by decohering. Considering the fact that the range of variation in resistance in the ordinary carbon transmitter is only about 10 or 15 ohms, and that of the coherer is about 5000 ohms, the results might be somewhat extraordinary. E. B. THORNTON.

ADDISON, N. Y.

Discoloration of Wires.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to your editorial and article in the issue of May 19, on discoloration of wires owing to their potential difference against ground, it might be interesting to learn that the German experience with the underground conduit has proved beyond any doubt that the negative conductor has a much higher tendency to accept ground potential than the positive. Engineers of the Berlin and Budapest lines consider it almost impossible to keep the negative conductor insulated for any length of time, while the positive one will then, of course, carry full potential against ground.

That American engineers do not seem to have had similar experience is owing to the fact that the climate is more favorable to insulation here than that at Berlin and Budapest. Besides, the system in New York does not offer a good chance to observe these conditions, because the potential of the single conductors is changed from positive to negative and vice versa, whenever there is a ground on a section.

NEW YORK. L. C. MARBURY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Temporarily Conducted by E. F. ROEBER, Ph. D.

DYNAMOS, MOTORS AND TRANSFORMERS.

Size of Brushes.—DETTMAR.—A long article, illustrated by many diagrams, giving an account of a long series of experiments which he made to determine the most favorable size of brushes for slip-rings and commutators. He agrees with Fischer-Hinnen, who has called the attention to the loss in the brushes (Digest, June 24, 1899), which has become more important in recent years, since carbon brushes have been introduced, for which the loss is considerably greater than for metallic brushes; therefore it is of practical importance to determine the best sizes of the brushes; he says that Fischer-Hinnen's formulas are not exact, as he did not consider the influence of the current density upon the contact resistance. (1) With regard to the contact resistance for slip-rings, he found that the exactness of the measurements cannot be very great, as with well-fitting brushes and a smooth slip-ring the contact resistance was found to vary, while the pressure of the brushes upon the slip-ring, the current density and the speed remained constant; variations of 20 to 30 per cent were found to be due to small mechanical vibrations, for instance, when a vehicle passed on the street at a distance of 160 ft.; he therefore endeavored to finish each single test in as short a time as possible; the results of his tests are given in diagrams. For copper gauze brushes upon bronze slip-rings with normal pressure the contact resistance is nearly independent of the speed, when the current density is 8 to 25 amperes per sq. cm. and when the speed is above 1 meter per second; but the contact resistance in motion differs considerable from the value at rest. Copper leaf brushes or brass leaf brushes upon the same bronze slip-ring, show an entirely different behavior, the contact resistance being no longer independent of the speed; but in all curves the contact resistances are smaller at rest than in motion. Different kinds of brushes behave more uniformly in regard to the dependency of the contact resistance upon the current density, the contact resistance decreasing with increasing current density. For soft carbon brushes upon bronze slip-rings, the contact resistance in motion is considerably greater than at rest, and for current densities from 4 to 15 amperes per sq. cm. the contact resistance in motion is nearly independent of the speed; analogous results were found with hard carbon brushes, the contact resistance being, however, 25 per cent greater than that of soft carbon. He concludes that it is wrong to base calculations upon measurements of contact resistances made while at rest; measurements should be made with a speed of at least 0.2 to 0.4 meter per second. (2) Discussing the best size of brushes upon slip-rings, he shows that there must be a most favorable value of pressure, as the contact resistance decreases with increasing pressure, while the friction loss increases. He determines the most favorable pressure for copper brushes by a graphical method; under average conditions the most favorable pressure is equal to the usual normal pressure; at high speed it is feasible to make the brushes touch the slip-ring very lightly only, and the more so, the smaller the current density. To press the brushes down hard, is entirely wrong, as the friction loss is increased more than is gained by the diminution of the contact resistance. With carbon brushes, the conditions are different; it is not so important to get the most favorable pressure, as with a pressure which differs not too much from the most favorable value, the loss is not much greater than with the best pressure. In average conditions, the best pressure is 140 gms. per sq. cm., which is in agreement with the pressures used in practice; also for carbon brushes, the rule should be followed that the brushes should touch the slip-ring only lightly, and the more lightly the smaller the current density. In regard to the most favorable current density, he found that for copper gauze brushes it should be as large as possible, as the loss is the smaller the greater the current density; for carbon brushes, the best current density is about that which is used in practice. (3) He then describes measurements of the contact resistance for commutators. The variation of the contact resistance with the speed is the larger the more the brushes jump; the contact resistance is practically independent of the speed, if the commutator is smooth and exactly circular, which is scarcely to be accomplished in practice. For copper gauze brushes, he found that at constant pressure and constant speed, the contact resistance varies much with the current density; at constant pressure and constant-current density the contact resistance is independent of the speed, if the speed is above 2 meters per second and the current density above 1.5 ampere per sq. cm. Analogous results were obtained with carbon brushes. (4) He then discusses the best size of brushes for commutators. In this case, there must exist a most favorable value of pressure, for the same reasons, as with slip-rings; but the most favorable pressure must have here smaller values, as the contact resistance upon commutators is greater than upon slip-rings. For copper gauze brushes, he finds that the most favorable pressure would have a value below that which can be used in practice, so that the rule is to make copper gauze brushes touch the commutators as lightly as possible. For copper brushes, at normal speed and greater current density, the best pressure is about that used in practice. In regard to the most favorable current density, he finds that, for a given pressure and coefficient of friction, it depends only upon the speed; if the speed is 11, 9, 7, 5, 3 meters per second, the theoretically best current densities would be 36.4, 31.4, 26.1, 20.5, 14.3 amperes per sq. cm. respectively for copper gauze brushes, and 8.7, 7.2, 5.8, 4.5, 3.0 amperes per sq. cm. respectively for soft carbon brushes. It follows that with copper gauze brushes only at low speeds is it possible to use the theoretically best current density in practice, while at higher speeds the current density should be as great as possible. For carbon brushes, the theoretically best current density is about that used in practice. He calculates the loss in the brushes in per cent of the total input for dynamos of different sizes, for dif-

ferent voltages and for different commutator diameters; the results are given in tables, and show that this loss for copper brushes is from a third to a half that in carbon brushes. Finally, he considers the increase of temperature and shows in a numerical example that the radiation of heat from the brushes, and even the brush-holders, is so great that considerable mistakes can be made in the predetermination of temperature, if this point is not properly considered.—*Elek. Zeit.*, May 31.

Dividing the E. M. F. of Continuous-Current Dynamos by Means of Induction Coils.—SENGEL.—A long paper, in which he continues his former researches, in which he had shown that there are a number of other devices besides that of Dobrowolsky, by which a three-wire system can be supplied from a single dynamo, as noticed in the Digest Sept. 3, 1898. In all these devices, current is taken off from one or several points of the armature winding by means of slip-rings, and connections are made with one or several induction coils. In the present paper he discusses the different devices, especially the dependence of the difference of potential in both halves of the system upon the differences of loads in both halves and the resistance and reactance of armature and induction coils. The first part is theoretical. He first treats analytically the device, in which there is only one slip-ring, connected to any point of the armature; this slip-ring is connected, by means of a brush, with the central wire of the three-wire system; this central wire contains an induction coil. If only one-half of the three-wire system is loaded, the current in this half is a pulsating continuous current, which is the sum of a pure continuous and an alternating current. The same is the case, if both halves of the three-wire system are loaded; the alternating-current component is the smaller, the greater the reactance of the induction coil. He then considers the device of Dobrowolsky, in which two opposite points of the armature winding are connected to two induction coils, and the central wire of the three-wire system is connected to the joining point of the two induction coils. He then discusses the case of three slip-rings with three induction coils, and the general case of n slip-rings with n induction coils. In all these cases he develops a formula for the difference of the e. m. fs. in the two halves of the system. This difference of the e. m. fs. is the smaller the more slip rings and induction coils are used; for an infinite number of slip-rings and induction coils it reaches a minimum value, which is, however, not zero. In the second part of the paper, he describes a series of experiments which he has made in order to examine his equations. In general, the measured and calculated values are in agreement.—*Elek. Zeit.* May 17, 24.

LIGHTS AND LIGHTING.

High-Efficiency Lamps for Isolated Installations.—WHITCHER.—An article calling attention to the fact that the boom of high-efficiency and short-life incandescent lamps against low-efficiency and long-life lamps has failed to materialize in anything like a general way, and that the standard practice is dropping back upon the old rule of at least 4-watt consumption per candle-power; this is said to be the fault of the non-technical consumer of electric light, who appreciates the failure of a lamp, but seldom studies the differences in current consumption. The article recalls some of the arguments for high-efficiency lamps, by comparing the cost of a private supply of electric light through an isolated plant with accumulator battery for a country residence requiring 100 lamps of 16 candle-power, if lamps of different efficiencies are used. The generating plant is supposed to be just large enough to supply the full number of lamps direct at reduced voltage or speed; and the battery is assumed to be capable of supplying the whole output for about seven hours. He compares lamps of 4 watts per candle-power and 700 hours' life, 3½ watts and 500 hours, 3 watts and 300 hours, 2½ watts and 200 hours, 2 watts and 100 hours; he gives an estimate of the cost of installation and operation for all cases. The total gross cost per year consists of the capital charges on the generating plant of 5 per cent, the capital charges on the battery, the sinking fund and insurance at 2½ per cent, the lamp renewals at 25 cents per lamp, and the working costs per annum This total cost is found to be $657.50, $615, $590, $552.50, $570, for 4, 3½, 3, 2½, 2-watt lamps respectively. The figures err on the side of the low-efficiency lamps, and show that a very large increase in the lamp-renewal bill must result, before the economical advantages, arising in all other respects out of the application of high-efficiency lamps, becomes annulled.—Lond. *Elec. Rev.*, June 1.

Public Arc Lighting in London.—A well-illustrated article on the public lighting in St. Martin's Parish, the current being supplied by a private company. Ninety-seven 10-ampere, 1000 nominal candle-power, open arc lamps have been erected; they are connected in circuits of 20 in series, on a 1000-volt circuit. Near the station the go and return cables run together, but in some parts a considerable amount of cable is saved by running them separately. In the case of alternating and rectified current arcs, the go and return mains cannot be separated in this way, on account of induction effects on neighboring telegraph and telephone circuits, and this advantage of the series-continuous-current method is often overlooked when comparing different systems. No attempt has been made to crowd in more than 20 arcs on the 1000-volt circuit, although some engineers assert that they have been successful in running nine lamps between 440 and even 400-volt mains. The lamps with their regulating coils take 45 volts each; no steadying resistances other than the series-regulating coils themselves are placed between lamps, but all is included in the regulating resistance at the station. The construction of the lamps and lamp posts is described in detail.—Lond. *Elec.*, June 1; more briefly in Lond. *Elec. Eng.*, June 1.

POWER.

Long Distance Power Transmission.—PERRY.—Two communications, criticizing the booster system, advocated by Forbes in his recent paper (Digest June 2, 9). He explains what he meant by stating in a paper in 1886 that the efficiency in an ordinary transmission system cannot be less than 50 per cent. He considers a case where the efficiency seems to be less than 50 per cent; generator voltage 1000, voltage at the motor 400, resistance of transmission line 3 ohms, current 200, power delivered 80 kilowatts, power lost in line 120 kilowatts, hence efficiency of transmission 40 per cent. He shows that if such a case could by accident exist, it could only continue to exist by some careful and curious way of governing the speed of the motor; for if the motor is allowed to run up in speed so that it may work at 600 volts, the current will be 133⅓ amperes, and, therefore, the same power, 80 kilowatts, is delivered, while the loss in the line is only 53⅓ kilowatts, so that the efficiency is now 60 per cent. He applies the same consideration to the figures of Forbes, which represent such unstable conditions, and shows that in a booster system, consisting of two sections, there can be no total efficiency less than 33 per cent, and no efficiency in either of the two sections less than 57½ per cent. In the second communication he regards the case, that 5000 kilowatts are delivered at a distance of 100 miles by direct current from a generator at 10,000 volts; he assumes the costs of power and of copper to be such that by the simple Kelvin law there ought to be 500 amperes per square inch in the copper; the current is continually boosted by an infinite number of infinitely small boosters. He gives a table for comparison of the results obtained; with the Ayrton-Perry rule, without boosters, with 16.4 per cent of drop of potential in the line, there is a total loss in the line of 2440 kilowatts, the total tons of copper are 1496; with the same rule, without boosters, with 8.19 per cent of drop of voltage, the respective values are 3108 kilowatts and 2561 tons, with the booster system, no drop of voltage, 4200 kilowatts, and 2022 tons. In the second and third case there is, therefore, a total loss of 27 per cent and 72 per cent, respectively, more than in the first case. He knows of no reasons why, with such a voltage and for such a distance, it should be at all necessary to use boosters, for a drop of 8 per cent is not important and the saving in not using boosters is very great. When no boosters are used, the most economical result as to ohmic loss and price of copper is obtained with a conductor of the same section throughout.—Lond. *Elec.*, June 1.

Economical Development of Manufactories.—An article referring to the growing competition of the United States and Germany with Great Britain. Reference is made to a paper, read by Arnold before the Birmingham Association of Engineers, in which he said that engineers in many cases are successful according to the manner in which they handle the commercial questions arising in manufactories, and that the future prosperity of many undertakings will largely depend upon the number of automatic machines used; further, that it is a mistake to class electrical machinery under the head of generating plant, as it is a link between the steam plant and the machinery that has to be driven; "electricity has the preference, where power is required in various small intermittent quantities, and covering a great area of ground; or where it is required in isolated buildings, such as explosive or inflammable mill manufactories; but in compact and well-arranged works the power absorbed in driving shafting and rope, or belting and gearing, does not exceed 20 per cent of the effective horse-power of the engine, and, in an up-to-date plant, it should not exceed half that amount, and can be run with much greater economy and efficiency."

The writer of the present article questions the last statement.—Lond. *Elec. Rev.*, June 1.

Refuse Destructors.—The first part of an article calling attention to the great number of large communities in England which have no refuse destructors. The slow progress made in the introduction of refuse destructors is said to be largely due to wild and extravagant claims made for them. No pecuniary consideration should weigh in the balance when deciding upon the best method, hygienically, of disposing of the refuse of a town; and, generally speaking, the worse the refuse is from a steam raising point of view, the more urgent is the necessity for its destruction by burning. Owing to the extreme variations in the character and quality of refuse, sometimes from hour to hour throughout the day, it is perfectly hopeless fuel for any purposes requiring a steady steam pressure. The average composition of the refuse of London and of Manchester is given in two tables.—Lond. *Elec. Rev.*, June 1.

Power Distribution in France.—An article on the extensions of the plant of the Loire River Electric Company. At present a new steam-driven Oerlikon alternator with an output of 1500 kilowatts is on order, generating three-phase current at 5500 volts, or at a pressure of half that, according to the choice of the company, the frequency being 50. The company now distributes power at a price which is much cheaper to the user than steam engines for all sizes up to 10 horse-power. The electric supply is rapidly replacing all small gas engines and steam engines in the district.—*Bull. des Usines Elec.;* abstracted in Lond. *Elec. Eng.*, June 1.

Water Power in South America.—A note of the electric plant of the city of Sao Paulo in South America. The power is taken from a waterfall, situated about 22 miles from the city, giving a fall of 71.5 feet, and capable of developing 25,000 horse-power. Double turbines are used, each of 48-in. diameter, and with a capacity of 3000 horse-power, and these are coupled to three dynamos situated at the ends of three totally independent lines running into the city.—Lond. *Elec.*, June 1.

TRACTION.

Tramway Return Currents.—TEICHMUELLER.—A full summary, illustrated by some diagrams, of the different methods which have been proposed to prevent the electrolysis of gas and water pipes by stray currents of tramway lines, in which the rails are used as return circuit. (1) The stray currents from the rails are not prevented, but the endeavor is, not to allow them to enter into the gas and water pipes. A great many suggestions have been made to accomplish this, either by connecting the rails at many points with earth plates placed into the under water, or by covering the pipes with an insulating paint, or by diminishing the conductivity of the pipes by means of intermediate insulating parts or joints, etc. But all these schemes have failed, especially the simplest means, namely, an insulating paint, has proved unsuccessful. (2) The stray currents from the rails are not prevented; they are even allowed to enter into the gas and water pipes; the endeavor is not to allow them to leave the pipes again. This is tried to be accomplished by the aid of the e.m.f. of an auxiliary source of current, by means of which the pressure in the rails is made to be always positive against the pressure in the pipes, so that the stray currents can flow from the rails to the pipes, but not from the pipes to the rails. Two diagrams show two possible connections; in the one the negative pole of the dynamo is direct-connected to the rails; this joint is connected to the positive pole of the auxiliary source of current, while the negative pole is connected with the pipes; in the other, the negative pole of the dynamo is direct-connected with the pipes; this joint is connected with the negative pole of the auxiliary source of current, while the positive pole is connected with the rails. He remarks that in practice it was found to be impossible to prevent the stray currents to leave the rails again and that, therefore, these methods should not be used. (3) It is the endeavor to prevent the stray currents from the rails at all. This may be done either by insulating the rails or by diminishing the tension of the rails. To insulate the rails properly, and without great expense, seems impossible at present. As to the decrease of the tension of the rails, he first remarks that he means the decrease of that tension which in entirely insulated rails would occur between any two points; in other words, the drop of voltage in entirely insulated rails. A decrease of this voltage drop can be accomplished (*A*) either by simply aiding the rails by other conductors, placed bare into the earth, which, however, is too expensive; or (*B*) by supplying certain points of the rails with the aid of insulated cables, in a similar way as lighting networks are supplied; the point of the rails, next to the station, is to be connected not direct with the dynamo, but a resistance is to be inserted; in the uninsulated feeders a greater voltage drop is allowed; the loss of energy in the feeders is a great disadvantage; this method has been often used in the past, but is not now favored. (*C*) A third method is to use the rails as the neutral conductor of a three-wire system; this method, which is certainly very practical, can be used in a few cases only, and without much trouble only if the line is throughout double track, as the three-wire system requires two equally loaded halves of the system, in order to make the current in the neutral wire zero. It is, however, possible to use two halves, differently loaded, by adding to the existing line as one-half of the system, another half containing only an e. m. f. and a conductor. He suggests the following scheme, which he gives in a diagram: The dynamo is connected in parallel with an accumulator battery; one end of the battery is connected to the trolley feeder; the other to the auxiliary conductor, which leads to the terminal of the rails at the end of the line. The other terminal of the rails, next to the station, is connected to a point of the battery, between the two ends; when the load of the line changes, this point must also be changed, which is done by a simple switch. This method can be easily used in installations, which have a battery; the regulations may become somewhat difficult, if the variations of the load in the line are great. This method seems not to have been used so far. A modification of the same idea, proposed first by Kapp, is to use a booster. The positive pole of the dynamo is connected to the feeder of the trolley wire, the negative pole of the dynamo is direct-connected to the positive pole of the booster; the common joint is connected to the point of the rails next to the station, while the negative pole of the booster is connected with the auxiliary feeder leading to the end of the line (in English journals the term "negative booster" is often used). This method involves a higher first cost than the other, just mentioned, but can be used also in a tramway system where no batteries are used, and besides it has the advantage of automatic regulation, because if the current in the trolley feeder is used for excitation of the booster, it can be arranged so that for any load the rails have the least possible current. This method appears to be the best and most effective which has been so far devised for preventing the stray currents; it is in successful use on the tramway lines of Bristol and Dublin in Great Britain, and on that of Schoeneberg, near Berlin, in Germany. The installations of Bristol and Schoeneberg are described.—*Elek. Zeit.*, May 31.

Central London Railway.—The first part of an illustrated description of this deep level, twin-tunnel electric railway, which has a length of 5.75 miles and 13 stations. It is designed to provide a two-minute and a half service of trains, but probably the service will ultimately be increased to two minutes. The power station is equipped on the three-phase, 5000-volt system, and the three-phase currents are transmitted at the generating pressure to sub-stations along the line, where they are transformed down and converted to 550 volts continuous current, which is fed at numerous points along the line from distributing cables to a third rail. The return current is carried through the track rails. There are at present three sub-stations. The machinery room of the station is illustrated. It contains six 850-kw, three-phase generating sets.—Lond. *Elec., Elec. Rev.*, June 1.

Electric Traction in Paris.—MONTPELLIER.—An article on the extension of the Orleans Railway Company into the centre of Paris, which has been already referred to in the Digest. The new line is to be operated by electric locomotives and is now nearly completed. The third-rail system is employed, the rails being used for the return current. Three-phase current is generated and transmitted at 5500 volts, the frequency being 25, and is converted by transformers and synchronous converters in sub-stations into continuous current of 550 volts, which is supplied to the third rail.—*L'Elec.*, June 2.

Russian Tramway.—WINKLER AND ORBAN.—A long, well-illustrated description of the electric tramway system of Jekaterinoslaw, which is a city of 150,000 inhabitants and the centre of a mining district in Southern Russia, and one of the first cities in Russia which introduced electric light and traction. The tramway plant contains four steam-driven, continuous-current dynamos, giving 580 volts, three each of 145 kilowatts, the fourth of 300 kilowatts. The trolley system is used, the rails being used for the return currents. Along the whole line, from the switchboard to the terminal station, an auxiliary wire, consisting of silicon bronze wire of 0.05 inch diameter, is drawn, for making certain measurements. At maximum load the voltage drop in the rails was found to be 2.6 volts per mile, which is the average of 4600 measurements. The consumption of fuel was 7.8 to 8.4 lbs. per

car-mile, which is considered as very good, as there are topographical and climatical difficulties.—*Elek. Zeit.*, May 24.

Berlin.—SCHUBERT.—An article discussing the question of adopting electric traction on the Berlin local and suburban railways, and advocating the greatest possible distribution of traffic. With electric traction he believes a 30-second service possible, instead of the present 5-minute service. In place of the nearly empty trains of 8 to 10 cars, with accommodation for 1450 passengers, which run during the periods of minimum traffic, a single car affording accommodation for 75 passengers might be despatched. Electric traction would render the present railways capable of dealing with a daily average of 253,000 passengers, while their present capacity in passengers carried amounts to only 143,000 per day.—*Zeit. des Ver. deut. Eisenb. Verw.;* abstracted in Lond. *Elec. Eng.*, June 1.

Electric Automobile.—An illustrated description of an electric automobile of English make. There are two small motors driving the two back wheels by ordinary bicycle chains, acting directly from a small sprocket pinion on the motor axle to a larger sprocket wheel fixed to the spokes of the carriage; these chains are adjustable as in a bicycle. The motors, devised by Joel, are each of 2 horse-power nominal; they work at 40 volts, run at 600 to 700 revolutions, and weigh 112 lbs.; each can give 3 horse-power. The armatures revolve outside the field magnets and act as flywheels, to keep the motion of the carriage steady. The winding of the armature is of the ordinary "barrel" type turned inside out; short pieces of square, insulated copper wire, all of exactly equal length and resistance, are passed through holes in the iron core of the armature; they are then bent obliquely, and connected by the shortest possible path one to the other at the ends, to form a wave-winding crossing the armature as many times in one complete coil as there are poles on the field magnets; when completed they form symmetrical flanges around the sides of the armature, with a minimum of non-active wire, an equal resistance in each coil, and little or no windage when revolving; the short bars can be easily taken out and replaced; the armature is said to bear an overload of 100 per cent. The two motors are carried by an independent and springy underframe, which is described in detail and illustrated. The current is supplied by two sets of batteries, 40 cells in all, each cell weighing 22 lbs. complete. The efficiency is said to be 12 watt-hours per lb. of complete cell, and 16 watt-hours per lb. of electrodes.—Lond. *Elec. Rev.*, June 1.

Rail Bonds.—HARRINGTON.—A well-illustrated, Franklin Institute paper on cast weld and surface contact bonds. He gives in tables the results of many measurements of cast weld joints without and with various bonds, and describes track tests of joints. He reaches the following conclusions: The cast weld joint alone has a resistance 30 per cent greater than the solid rail section; the use of sheet copper, as furnished by the Ajax Company, makes the combined resistance 20 per cent less than the solid rail section; where the cast weld joint is not used and the usual fish-plate form of construction adopted, the flat sheet surface contact form of bond, known as the Ajax, makes the most efficient type of bond, both electrically and mechanically, making the resistance only slightly more than the rail section against the other types of bonds, whose resistance runs from three to four times more. Some general remarks are added on the number of bonds to be placed and on the carrying capacity of rails.—*Jour. Frank. Inst.*, June.

REFERENCES.

Austrian Electric Railway.—A note stating that a funicular railway has been proposed for Trieste to connect with Opcina. The line will be narrow gauge and 3.1 miles long. The steepest portion of the line, the gradient of which is 1 in 4, will be laid down on the rack and pinion system.—Lond. *Elec.*, June 1.

Electric Launches.—An editorial note recommending electric launches for the Thames River as eminently feasible. Small river launches driven by steam are essentially inefficient, while small electric launches capable of carrying from 100 to 150 passengers are as efficient as would be electric launches of much larger dimensions, and are far more efficient than steam. The life of storage cells is much greater in river service than in road vehicles, as the injury due to mechanical shocks and vibrations is absent.—Lond. *Elec.*, June 1.

Accessories of Electric Traction.—COTTRELL.—A continuation of his long, illustrated serial, noticed in the Digest Sept. 23. This part deals with switchboards.—Lond. *Elec. Rev.*, June 1.

Distributing Systems for Electric Traction.—SAYERS.—The conclusion of his paper (Digest, June 9, 16), together with the discussion which followed.—Lond. *Elec. Eng.*, June 1; a continuation in Lond. *Elec. Rev.*, June 1.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Buxton.—A note on the recently-opened electric plant of that British town. The three-wire system of supply is used, the voltage being 230. For the day load, a battery of 260 Tudor cells has been installed, with a capacity of 250 ampere-hours and a maximum discharge rate of 100 amperes.—Lond. *Elec.*, June 1.

Two-Phase Plant in Bleaching Works.—A brief, illustrated description of an English bleaching plant operated with the two-phase system. The motors are induction motors, ranging between 75 horse-power and 5 horse-power. The installation is said to prove very satisfactory.—Lond. *Elec. Rev.*, June 1.

REFERENCE.

Electric Light in Country Houses.—PERKINS.—An illustrated article on the electric equipment of English country houses.—*El'ty*, June 13.

WIRES, WIRING AND CONDUITS.

Heating of Underground Conductors.—WILKENS.—An article calling attention to the importance of a systematical investigation of the safe carrying capacity of underground cables. He treats analytically the case of a conductor of circular cross-section, in earth; when a current is sent through it, the Joulean heat is dissipated into the surrounding earth, and the process will be stationary, when at any point the temperature becomes constant. He develops the equations of this stationary condition; in these equations a term, called active heating zone, is important, which represents the length, measured in the direction of the radius of a cross-section, to which in the earth the heating effect of the current extends, so that at the end of this length the ordinary temperature of the earth is kept constant. He discusses how long a time it takes until the process becomes stationary; he found experimentally that in heavily-loaded cables it took some hours, before the increase of temperature per unit of time became relatively small, and even after several days the process had not yet become strictly stationary. Of great importance are the daily periodical changes of the temperature of the earth; they cause great differences in the values of the active heating zones, if other things are equal. He made a series of measurements of the specific resistivity for heat of the earth; he determined the drop of temperature, necessary to conduct a given quantity of heat, generated per unit of time, through a layer of earth of given size; the arrangement of his experiments is described. He found the specific resistivities for heat of sandy earth, wax, air and water to be 5.23, 3.29, 11.8 and 4.98 respectively. He made a series of experiments, in which he measured the active heating zone under different conditions and at different days, each experiment lasting 24 hours; the results are given in a table; it appears that the changes of temperature of the atmosphere have a great influence, and that, due to this influence, the length of the active heating zone is relatively small; the values obtained are between 0.44 and 1.81 in.; if several conductors are placed close together, the values obtained for the active heating zone are more uniform and higher, than otherwise; with three conductors he got 1.62, 1.54 and 1.81 in. To draw from these experiments conclusions as to the actual conditions in cable networks, it is to be considered, that in most cases the maximum load lasts only a few hours, so that the heating zone should be smaller than the values measured by him. He then discusses the influence of different materials, used for the insulation of the cables; the heating of the insulation causes a considerable decrease of the insulation resistance and increases the danger of a breakdown. He allows as a safety limit of the temperature of the insulation 45 degs. C., and assumes that the temperature of the earth is 15 degs. C., so that the heating by the electric current must not cause an increase of temperature of more than 30 degs. C.; this gives a safety limit of the current, and therefore that current at which the safety devices must work; if they are fuses, the normal current, supplied to the cable, is to be half the maximum-limit current, as otherwise with lasting higher load, the fuses would be soon destroyed by oxidation; if, however, cut-outs are used, which are not attacked by any lasting current below that at which they have to interrupt the current, the normal current may be three-fourths of the maximum-limit current. From his formulas he calculates for different copper cross-sections the following values: maximum limit of current for a rise of temperature of 30 degs. C. and for an active heating zone of 2 ins., normal current if fuses are used and if automatic cut-outs are used, and normal current density with the use of automatic cut-outs; if the copper cross-section in square inches is 0.025, 0.054, 0.109, 0.287, 0.775, 1.550, the current density in amperes

per square inch is 4,800, 3,241, 2,339, 1,516, 994, 742. Finally he discusses briefly the drop of temperature in the insulation and calculates it for a special case. The article is illustrated by many diagrams.—*Elek. Zeit.*, May 24.

ELECTRO-PHYSICS AND MAGNETISM.

Absorption of Electric Waves.—FLEMING.—A communication describing some results which he has obtained with an apparatus for the production and detection of electric waves, having small wavelengths, about 8 ins. The apparatus is not described, but it is said to be especially adapted for testing quantitatively the absorptive powers of various substances for electric waves. He found that paraffin oil, benzol, turpentine and all insulating liquids of low dielectric constant prove to be exceedingly transparent, but water, and many liquids of high dielectric constant, are very absorptive. Ice, if dry on the surface, is transparent to the waves; the refractive index was found to be a number near to 1.7 or 1.8 (this is in agreement with the measurements of Gutton, see the abstract below). The human hand and body are very opaque to these waves. The waves are absorbed by some vapors, for instance, the red, nitrous fumes produced by the action of nitric acid on copper absorbs them to some extent, even if only a few inches in depth. Any substance which has conductivity or large dielectric constant in one direction only, is very absorptive of these rays, when that direction is placed parallel to the electric force of the ray falling upon it; thus a paper of pins stops the rays when the pins are held with their length parallel to the direction of the electric force, but not when they are held normal to it. The experiments seem to prove so far that all substances which contain in their chemical molecule either hydroxyl or nitryl, are in the liquid and perhaps in the gaseous form very opaque to electric radiation, the wave length of which is not more than a few inches.—Lond. *Elec.*, June 1.

Electric Dispersion of Ice.—GUTTON.—An account of experiments in which his method for comparing the rates of propagation of electric waves through bitumen with and without wires (noticed in the Digest May 26), was used for determining the dielectric constant of ice. He found the refractive index of ice to be 1.76, which gives a dielectric constant of 3.1, while Blondlot had found it to be 2.0. He supposed dispersion, and measured therefore the refractive indices for different wave lengths, the range of the latter being from 14 to 2000 cm. For the smallest wave length the refractive index is 1.76, for a wave length of 25 cm. it is 1.73, for a wave length of 2088 cm. it is 1.5, which gives a dielectric constant of 2.25, in sufficient agreement with Blondlot. Within the region investigated the dispersion of ice is normal.—*Comptes Rendus*, XX., Apr. 23; abstracted in Lond. *Elec.*, June 1, and in *L'Ind. Elec.*, May 10.

Electromagnetic Mechanism.—FESSENDEN.—The first part of a Franklin Institute paper on "electromagnetic mechanism, with special reference to telegraphic work." In this part he deals with electric units and says, what the practical man wants is a system in which there are no so-called practical units, but all the units are absolute; a system of prefixes to denote the power of ten by which the absolute unit is multiplied; one name, with different prefixes and suffixes for all terms connected with each single unit. He then gives equations representing the relations between the electric and magnetic units and the fundamental units of the c. g. s. system, and makes some applications of his equations which, however, are too mathematical to be abstracted here. They relate to the energy stored up in a condenser.—*Jour. Frank. Inst.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

Contact and Chemical Theories.—LODGE.—A continuation of the reprint in full of his presidential address to the British Physical Society on the controversy concerning Volta's contact force (Digest, Mar. 17, Apr. 28). This part deals with the osmotic pressure or diffusion views of a voltaic cell. He gives a brief and rather original outline of Nernst's theory of concentration cells, and quotes some instances of comparison between measurements and calculations. "These agreements, though not perfect, are clearly far and away beyond anything attributable to chance, and they practically substantiate the essential features of Nernst's theory; a theory which seems to me to rank high among rational calculations of this kind." For pure concentration cells, i. e., cells consisting of different concentrations of the same electrolyte, with identical electrodes, "this diffusion theory clearly represents a great step in the direction of the truth, even if it cannot be asserted at present to be the whole truth." The ground of Nernst's theory is said to become less secure and satisfactory, when the so-called solution-pressure of a metal itself has to be taken into consideration. He considers the ordinary Daniell cell, and discusses where its e. m. f. may be located. He then gives an outline of the electron or corpuscular view of voltaic action, and of Helmholtz's view of electric mass-affinity.—*Phil. Mag.*, May. A brief abstract of the discussion which followed this paper, in Lond. *Elec.*, May 25; Lond. *Elec. Rev.*, June 1.

Capacity of Accumulators.—JUMAU.—An abstract of a paper giving an account of an investigation of the relation between the capacity and the strength of acid in cells of the Faure type. The capacity increases at first, and then decreases as the strength of the acid is increased, but the concentration which gives a maximum rises with the rate of discharge. The same is true of the positive and negative plates separately; the maxima, however, do not occur at the same values for the concentration, the capacity of the negatives falling off with a strong acid. The greatest capacity would be found in a cell in which the plates were separated, and having strong acid around the positives and dilute acid around the negatives. This being impossible in practice, the strength of acid should depend on the rate of working, and the area of the negative plates should be greater.—Lond. *Elec.*, June 1.

Extraction of Gold from Sulphite Ore.—An editorial note on the Riecker electrolytic process which consists in agitating the ore in a finely-divided state with a solvent containing sodium chloride and potassium cyanide, and at the same time passing an electric current through the mass of ore and water, with iron anodes and amalgamated copper cathodes over which mercury is kept flowing constantly. The coarser particles of pure gold are said to be directly amalgamated, while the finer particles and the chemically-combined gold are dissolved by the cyanide and then electro-chemically deposited upon the cathode by means of the current. The cost of treatment amounts to $1.66 per ton, and the process is about to receive trial upon an extended scale at the Kalgurli mine in Australia. The writer waits for further information before pronouncing any decision upon the process.—Lond. *Elec.*, June 1.

REFERENCES.

Battery.—TROWBRIDGE.—A brief article on the 20,000 cells battery of the Jefferson Physical Laboratory, Harvard University, which was noticed under Röntgen rays in the Digest, June 16.—*Elec. Rev.*, June 6.

Reversibility of Voltaic Cells.—MOORE.—The full illustrated British Physical Society paper, an abstract of which was noticed in the Digest March 31.—*Phil. Mag.*, May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard Resistances.—GLAZEBROOK.—An abstract of a British Physical Society paper, in which he describes three methods for building up multiples of a standard resistance, such as a 1-ohm coil. The first method consists in making as accurately as possible three 3-ohm coils. These in parallel can be compared directly with the standard by Foster's method. Their resistance in series is very approximately nine times that in parallel, and hence an accurate determination of a resistance about 9 ohms can be obtained. If then this resistance is put in series with the standard, an accurately-known 10-ohm resistance is obtained. By a similar process, a hundred or a thousand-ohm coil can be built up. The second method consists in calibrating a resistance box. The 1-ohm coils of the box are compared directly with the standard, and the other resistances determined accurately by a building up process, using a subsidiary resistance box. In comparing the high resistances, the difference between the two boxes may be so great as to send the balance off the bridge wire. In this case the third method is employed. The equal arms of the bridge are accurately known, and one of them is shunted with a resistance, which need not be accurately known, until the reading is brought back into the wire. The coils chiefly used throughout the experiments are made of platinum silver. In the discussion, Trotter asked if proper allowance could be made for the large number of mercury cups used in the first method. Glazebrook replied that he had investigated the resistance of the mercury contacts and found it to be negligible.—Lond. *Elec. Rev., Elec. Eng.*, June 1.

Mercury Jet Interrupter.—KINTNER.—A description of a high-frequency interrupter, which allows to vary and measure the frequency easily. An iron vessel arranged as a Mariotte flask to maintain a constant head, holding about a pint of mercury, forms one terminal and a metallic plate the other; the latter is placed below the vessel, and the mercury falls upon it, completing the circuit. In the bottom

of the flask is a row of ten holes, arranged around a circle, with nozzles fitted into them. On a vertical shaft, concentric with the row of nozzles, a series of mica sectors is arranged, so that, when revolving, they cut the mercury jets falling from the vessel above. These strips are placed with the line of their edges parallel to the axis of the shaft. The jets are all in parallel, and when the mica strips are revolving, the head is so adjusted, by the Mariotte flask arrangement and screws on the sides of the reservoir, that at the instant of interruption of one jet, all the others are in a state of interruption; but the one directly in front of the mica strips will be the first to make the circuit. The frequency of interruption can be varied by variation of the speed, of the number of nozzles, of the number of sets of mica strips, or by a combination of the three.—*Nature*; Lond. *Elec.*, May 4.

Armored Galvanometers.—DUBOIS AND RUBENS.—A description of galvanometers protected in such a way that any other magnetic field is totally absent, except the artificial field which is created and measured. The best form of magnetic shielding is by a spherical shield; they overcame technical difficulties by the preparation of a special cast steel capable of taking a thin spherical surface; it has a high initial permeability and very small coercive force. It is not only used for the two hemispheres of the outer armor, but also for a special armoring of the coils themselves. The planes dividing the outer and the inner hemispheres, respectively, make an angle of 90 degs. between them, and the combined system gives a production amounting to a hundred-fold reduction of the disturbance. Usually a cylindrical outside armor is added, which makes the protection a thousandfold. Quartz fibres are used for suspension.—*Zeit. fuer Instrumentenkunde*, March; abstracted in Lond. *Elec.*, June 1.

REFERENCE.

Power Measurements in Three-phase Circuits.—Two illustrated communications, describing practical methods; they do not seem to contain anything new.—Lond. *Elec. Eng.*, June 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy in Germany.—A note taken from a German daily paper, stating that successful experiments have recently been made at Bremerhafen with the Schaefer system of wireless telegraphy, which was noticed in the Digest Aug. 19. An apparatus, with a wire 205 ft. high, has been put up for the North German Lloyd at Kaiserhafen, to effect communication between Bremerhafen, a lighthouse at Borkum, and a fireship. It is hoped also to signal successfully between Heligoland and Bremen, a distance of nearly 100 miles. The large Lloyd steamers are gradually all to be equipped with Schaefer apparatus. The German lightship at the mouth of the River Ems has been provided with a set of Marconi apparatus, by means of which messages will be exchanged between ships at sea and the land telegraph station on Borkum Island. A charge of 20 cents is to be made in addition to the ordinary telegraph charges.—Lond. *Elec.*, June 1.

Telephonograph.—A description of an instrument invented by Paulsen. He has replaced the wax cylinder of the Edison phonograph by a steel band, and the style by an electromagnet energized by a telephone. Currents transmitted by the telephone pass through the electromagnet and create consequent poles on steel band, and more or less the converse operation is used for reproducing the sound. A telephone subscriber on leaving his office may set such a telephonograph to receive telephoned messages during his absence.—Lond. *Elec. Rev.*, Apr. 27; Lond. *Elec.*, May 4.

ALIAMET.—An illustrated description of the same instrument.—*L'Elec.*, June 2.

—An editorial on the same instrument which the writer saw in operation. The instrument is said to reproduce the sounds with the same clearness and exactness as the telephone. The number of times a record may be used is said to be practically infinite, as speech was reproduced 1200 times, without showing any diminution in the sounds. An improvement of Pedersen is also described, by which two speeches can be recorded on the same steel band at the same time, by the use of two electromagnets instead of one.—*Elek. Zeit.*, May 17.

REFERENCES.

Transatlantic Telephony.—An interview with Pupin, who said that telephony through a submarine cable is possible under the system described in his recent A. I. E. E. paper, but its commercial practicability is doubtful. The real use of his system will be in telegraphy. The influence of the capacity of a line, and the way in which he annuls the effect of the capacity is explained in a general, popular way.—*Elec. Rev.*, June 6.

Telephone.—MONTILLOT.—A well illustrated description of telephone transmitters and receivers devised by Ducousso.—*L'Elec.*, June 2.

Telephone Office.—HIGGINS.—An article on the management and care of a modern telephone central office, in which the common battery system is used. The operation of the switchboard, the duties of the chief operator, day inspector and night inspector, the care of the machines and the accumulators, and the use of special signs or marks are discussed.—*El'ty*, June 13.

Michigan.—WARE.—A statistical article on the Michigan telephone situation.—*El'ty*, June 13.

London.—The first part of an illustrated reprint of the English article on the scheme for "the telephoning of London" by the government, noticed in the Digest June 2, 9.—*El'ty*, June 13.

MISCELLANEOUS.

United States Mineral Production.—A statistical article, with tables, giving production of ores and minerals in the United States for 1899 and comparing them with 1898. The total value at the place of production of the mineral and metal output of the United States in 1899 was $1,211,361,861, as against $861,751,017 in 1898, which amounts are quite unexampled in the history of the mineral industry. The production of aluminum was 6,500,000 lbs., $2,112,000 in 1899, against 5,200,000 lbs., $1,690,000 in 1898. The production of copper increased from 535,900,232 lbs., $63,129,047, to 581,319,091 lbs., $100,916,994. The production of carborundum reported by the sole producer was 1,741,245 lbs., $156,712 in 1899, against 1,594,152 lbs., $151,444 in 1898, the decline in value being due to the increased proportion of the cheaper grades marketed.—*Eng. and Min. Jour.*, June 9.

Aluminum.—RICHARDS.—A Franklin Institute paper on recent progress in the aluminum industry. The process of reduction has been somewhat improved in details, but in principle is the same as the Hall process of ten years ago; details of operation are kept secret. The cost price of aluminum is probably about 20 cents per pound at present, while its selling price is slightly over 30 cents in the United States and 25 cents abroad. He refers to the successful manufacture of light, strong aluminum alloys, which may find a wide field of application to light running machinery, portable apparatus, vehicles, etc. He makes some remarks on the various uses of aluminum which have recently appeared; for culinary ware, in the lithographic printing branch, and for electric transmission lines. Aluminum can be rolled out to 0.0005 inch in thickness and then beaten out to 0.000025, or even 0.000014 inch. Powdered aluminum is used in the reduction of refractory metallic oxides to the metallic state. He refers to the process of Goldschmidt of producing high temperatures (Digest Sept. 2).—*Jour. Frank Inst.*, June.

Lightning Fatalities.—An abstract of a U. S. Weather Bureau report, compiled by Henry. During the last year the loss of life by lightning in the United States was greater than in any year since statistics began to be collected; 562 persons were killed and 820 injured in 1899; 45 per cent of the fatalities occurred in the open, 34 in houses, 11 beneath trees and 9 in barns. The following rules are recommended to be observed during thunderstorms: In a house, chimneys and open windows should be avoided; the safest place is probably the middle of the room; outdoors one should never seek the shelter of trees, while fences and live stock should be avoided.—*Elec. Rev.*, June 6.

A New Substitute for Rubber.—An article on a shrub growing wild abundantly in Central Mexico and known to the Indians by a variety of names which Yule is one, the botanical name being *synathereoeas mexicana*. Within its bark and wood there is a large amount of gumming matter and upon cutting it finely, grinding or pounding it, and macerating it with a hydrocarbon solvent, such as gasoline, naphtha, turpentine oil, etc., this gum is softened and extracted from the wood and when extracted does not harden to crystallization, but still holding a small portion of the hydrocarbon remains as a viscid, sticky mass that fulfils all of the physical conditions of crude rubber. It may be vulcanized perfectly, is free from all mechanical impurities and needs no preliminary cracking or grinding, and washing, as does the ordinary crude rubber. The process of preparing the composition for the market is described.—*Sc. Amer.*, May 19.

REFERENCES.

Manufacturing Plant.—The conclusion of the illustrated article on Ferranti's Hollinwood Works (Digest June 9, 16). A continuous-current lighting and traction switching-gear is described at some length and some remarks are added regarding Ferranti transformers.

Drawing Office.—WARREN.—A description of the drawing office system of the Bullock Electric Manufacturing Company.—*Amer. Mach.*, June 7.

Electric Welding.—Two illustrated communications discussing the advantage of the electric-welding process over ordinary forge-welding. Some forms of electric welder are described.—Lond. *Elec. Eng.*, June 1.

GUILLAUME AND POINCARE.—A long article calling attention to the importance of the International Congress of Physics from Aug. 6 to 12, and discussing the subjects of its programme.—*Revue Gen. des Sciences*, May 30.

German Patent Law.—A paper by Hefner-Alteneck, read before the Electrotechnical Society of Berlin, on proposed amendments to the German patent law.—*Elek. Zeit.*, Apr. 5; the discussion which followed this paper and the report of a special patent committee of the society, signed by Goerges, in *Elek. Zeit.*, May 10.

Manufacturing Plant.—A continuation of the illustrated article on Ferranti's Hollinwood Works (Digest, June 9). This part deals with the development of Ferranti's rectifier to its present type, and gives a long description of the Ferranti switch gears.—Lond. *Elec. Eng.*, May 25.

Paris Exposition.—Brief, illustrated descriptions of the electric rolling bridge and crane, constructed by Flohr, Berlin.—*La Nature*, May 26; Lond. *Elec. Rev.*, May 25.

An illustrated description of the moving platform.—*Cosmos*, May 26.

BLONDIN.—An illustrated article on the decorative illumination of the palace of electricity.—*L'Eclairage Elec.*, May 19.

ALIAMET.—An illustrated description of a differential lamp for continuous and alternating current, devised by Bardon; 1400 lamps of this type are installed in the Exposition.—*L'Elec.*, May 26.

Paris Exposition.—An article on the generating plant, giving in tables some information on the engines, dynamos and boilers, and their makers.—Lond. *Elec. Rev.*, June 1.

An illustrated description of some electrical features of the Exposition.—*Elec. Rev.*, June 6.

New Books.

TRAITE ELEMENTAIRE D'ELECTRICITE. Avec les Principales Applications. Par R. Colson. Third Edition. Paris: Gauthier-Villars. 272 pages, 91 illustrations. Price, 3.75 francs.

This is an elementary book devoted to the principles and applications of electricity. It is divided into 16 chapters, of which I.-V. treat of fundamental principles, VI. and VII. of units and measurements, VIII. of electric sources, IX. motors, X. transformers and accumulators, XI., heat and light, XII. electro-chemistry, XIII. power distribution, XIV. telegraphy, XV. telephony and XVI. numerical examples.

The style is simple, elementary and attractive. The book is not suitable for advanced students, in view of the wide territory covered in its chapters. Moreover, the descriptions are not always rigidly accurate from a scientific standpoint, or of the most recent date. With elementary students, however, the book should be acceptable and popular.

BOOKS RECEIVED.

LEZIONI DI ELETTROTECNICA. Dettate Nel R. Museo Industriale Italiano in Torino da Galileo Ferraris. Volume Primo. Fondamenti Scientifici dell' Elettrotecnica. Torino: Roux Frassati e Co. 432 pages, many illustrations. Price, 15 lires.

HANDBUCH DER ELEKTRISCHEN ACCUMULATOREN. Auf Grundlage der Erfahrung und mit besonderer Berücksichtigung der technischen Herstellung. Von Paul Schoop. Stuttgart: Ferdinand Enke. 514 pages, 193 illustrations. Price, 12 marks.

ELEKTROCHEMISCHE UEBUNGSAUFGABEN. Fuer das Praktikum sowie zum Selbstunterricht. Von Dr. Felix Oettel. Halle a. S.: Wilhelm Knapp. 53 pages, 20 illustrations. Price, 3 marks.

THEORIE UND PRAXIS DER ANALYTISCHEN ELEKTROLYSE DER METALLE. Von Dr. Bernhard Neumann. Halle: Wilhelm Knapp. 224 pages, 65 illustrations. Price, 7 marks.

INSTRUMENTS ET MÉTHODES DE MESURES ÉLECTRIQUES INDUSTRIELLES. Par. H. Armagnat. Paris: Georges Carré et C. Naud. 586 pages, many illustrations. Price, 12 francs.

DIE WIRKUNGSWEISE, BERECHNUNG UND KONSTRUKTION ELEKTRISCHER GLEICHSTROM-MASCHINEN. Von J. Fischer-Hinnen. Fourth edition. Zürich: Albert Raustein. 410 pages, 394 illustrations and 3 tables. Price, 13.20 marks.

HANDBUCH DER ELEKTRISCHEN BELEUCHTUNG. Von Jos. Herzog und C. P. Feldmann. Berlin: Julius Springer. 521 pages, 428 illustrations. Price, 16 marks.

JAHRBUCH DER ELEKTROCHEMIE. Von W. Nernst und W. Borchers. Berichte über die Fortschritte des Jahres 1894-5-6-7. Halle: Wilhelm Knapp. 1894—274 pages, 163 illustrations. 10 marks. 1895—300 pages, 196 illustrations. 12 marks. 1896—359 pages, many illustrations. 1897—411 pages, many illustrations. 15 marks.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Next meeting, Paris, Aug. 16, 1900.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, September, 1900. Place to be selected.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

Notes of the Independent Telephone Convention, Cleveland, O.

THE ILLINOIS ELECTRIC COMPANY, Chicago, was personified in Mr. H. E. Adams.

THE STANDARD ELECTRIC COMPANY, Cincinnati, was represented by Mr. Charles S. Nolloth.

THE MCDERMID MANUFACTURING COMPANY, Chicago, was represented by Mr. Charles L. Burlingham.

THE F. BISSELL COMPANY, supply dealers, Toledo, Ohio, was represented by Messrs. Bissell and Hamilton.

THE ELECTRICAL SUPPLY & MANUFACTURING COMPANY, Cleveland, was represented by Mr. H. Whitford Jones.

THE MENOMINEE ELECTRICAL MANUFACTURING COMPANY, Menominee, Mich., was represented by Mr. Tideman.

MR. W. W. LOW, president of the Electric Appliance Company, of Chicago, was present, assisted by Mr. S. A. Dinsmore.

THE GARL ELECTRIC COMPANY, Akron, Ohio, was represented at the convention by Messrs. Max Schumacher and M. Garl.

THE CHICAGO INSULATED WIRE COMPANY, Chicago, was well represented by the old-time convention "war-horse," Mr. W. M. Smith.

THE CENTRAL ELECTRIC COMPANY, Chicago, had its interests looked after by General Manager Charles E. Brown and Mr. F. M. Pierce.

THE HOLTZER-CABOT ELECTRIC COMPANY, of Brookline, Mass., was represented by its Western manager, Mr. Edwin R. Harding, of Chicago.

THE WALWORTH & NEVILLE MANUFACTURING COMPANY, Chicago, had an exhibit of cross-arms, pins and brackets, including Washington fir arms.

MR. LORON MITCHELL, Portsmouth, Ohio, manufacturer of locust and white oak insulator pins and white oak brackets, was present in the interests of his line.

MR. T. H. BAILEY WHIPPLE, general sales agent for the Jandus Electric Company and the Buckeye Electric Company, Cleveland, was present at the convention.

MR. C. S. POWELL, the Cleveland representative of the Westinghouse Electric & Manufacturing Company, was present at most of the sessions of the convention.

THE NATIONAL INDIA RUBBER COMPANY, Bristol, R. I., was represented by F. P. Lyons, who exhibited samples of N. I. R. insulated wires and cables of many varieties.

W. J. BARR, of Cleveland, inventor of the Barr patent transmitter arm with concealed cord, was at the exhibition. He is preparing to furnish his arm in large quantities.

THE BRIDGEPORT BRASS COMPANY, Bridgeport, Conn., was represented by Messrs. Wylie Brown, T. R. Yaloy and H. G. Madden. This company manufactures all kinds of wire.

THE VALENTINE-CLARK COMPANY, Chicago, was ably represented by its treasurer, Mr. E. L. Clark, who never lost an opportunity to announce the fact that he still had poles for sale.

THE CONSUMERS RUBBER COMPANY, Cleveland, showed a line of rubber specialties and mica. The company claims to handle "every thing made of rubber." Mr. S. R. Driffield was in charge.

THE MILLER CHEMICAL ENGINE COMPANY, Cleveland, exhibited a line of various kinds of fire extinguishers and hand chemical engines. A. M. Barnes, president and general manager, was in charge.

MR. JOHN T. MCROY, of New York, manufacturer of the well-known McRoy conduits, was a diligent attendant at the convention hall. The delegates learned a good deal about these conduits.

THE LESCHEN-MACOMBER-WHYTE COMPANY, Chicago, exhibited a fine line of samples of iron, steel and copper wire, bare and insulated. President George S. Whyte, a convention favorite, was in charge.

MR. G. H. SARGENT, of the Sargent Company, Chicago, visited the convention to announce to his numerous friends that his company is still prepared to furnish steel and brass castings of every description.

THE AMERICAN WATCHMAN'S TIME DETECTOR COMPANY, Cleveland, showed several styles of its well-known watchman's time detectors. Mr. A. B. Foster, president of the company, was in charge.

THE AVERY STAMPING COMPANY, Cleveland, made an exhibit of a full line of shims, washers, braces and pressed steel work for telephone line construction. Douglas Perkins and Harry M. Avery were in charge.

THE ELECTRICAL CONSTRUCTION SUPPLY COMPANY, Springfield, Ohio, was represented by Mr. J. D. Rodgers. The exhibit consisted of a line of specialties including the well-known Chubbick pin and break arm.

THE AMERICAN STEEL & WIRE COMPANY, Washburn & Moen department, was represented by Messrs. H. I. Pratt and Chauncey T. Gage. They showed a full line of the company's numerous varieties of wire for telephone use.

THE MOON MANUFACTURING COMPANY, Chicago, was ably represented by General Manager H. E. Procunier. It is said that he experienced no difficulty in securing unlimited orders for the company's well-known terminal heads.

THE WARNER ELECTRIC COMPANY, Muncie, Ind., was represented by Messrs. W. F. and T. W. Warner, who interestingly and effectively demonstrated the advantages claimed for the Warner pole changer, which was shown in operation.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, was represented by Mr. George Conover, who exhibited a line of electrical specialties, including fuses and lightning arresters. A neat aluminum stamp case was distributed as a souvenir.

THE NATIONAL CARBON COMPANY, Cleveland, showed a complete line of batteries and carbon specialties. These goods are too well known to require enumerating, and they received much attention. The company was represented by N. C. Cotabish, E. J. Climo and M. H. Moffett.

THE AMERICAN VITRIFIED CONDUIT COMPANY, New York, showed samples of various kinds and sizes of conduits. Special attention was called to a new interchangeable conduit by the use of which cables can be changed from one to two and from two to three ducts. Mr. F. L. Packard was in charge.

THE VARLEY DUPLEX MAGNET COMPANY, Jersey City, N. J., was represented by President Varley, assisted by the company's Western manager, Mr. J. M. Knox, of Chicago. These gentlemen were being constantly sought by reason of the fact that they brought with them a supply of attractive souvenirs.

THE MONARCH FIRE APPLIANCE COMPANY, New York City, exhibited its "Kilfyre," which has proven a success as a fire extinguisher. Thursday afternoon a practical demonstration of the merits of the article was given by extinguishing a fire started for the purpose. Mr. C. H. Barney was in charge.

THE NUNGESSER ELECTRIC BATTERY COMPANY, Cleveland, was represented by Messrs. P. H. Nungesser and A. B. Foster. They exhibited numerous samples of their dry batteries for telephone service and closed-circuit batteries for switchboard and central-energy systems. The exhibit was neat and effective.

MRS. S. H. COLE, of Warren, Ohio, interested the delegates with a device for deaf persons who use telephones. It consists of a funnel-shaped hard-rubber extension for the receiver, which is screwed on in place of the ordinary cap. Mrs. Cole had a number of recommendations from people who have used the device.

THE AMERICAN TOLL TELEPHONE COMPANY, Cleveland, was the only manufacturer of toll pay-station machines present, exhibiting its devices for the first time. The apparatus manufactured by this concern was described and illustrated in the last issue of this paper. Messrs. E. F. Kaneen and W. A. Foss were in charge.

THE AMERICAN ELECTRIC TELEPHONE COMPANY was well repaid for its attractive exhibit at the Cleveland Telephone Convention last week. The first day, the company closed a contract for 2200 instruments, and before the end of the week had sold nearly every piece of apparatus on exhibition, including a 100-drop switchboard.

THE EUREKA ELECTRIC COMPANY, Chicago, was represented by Messrs. I. J. Kusel, W. R. Shaw, H. J. Kusel and G. B. Pratt. The company had an exhibit of switchboards and various kinds of telephone instruments, making a special feature of a new receiver and desk set. The Taylor cable terminal was prominently displayed.

THE KEELYN TELEPHONE MANUFACTURING COMPANY, Chicago, exhibited a line of lightning arresters, bridged, series and express telephones. A combined fuse and carbon lightning arrester measuring one-half by one inch attracted considerable attention. This exhibit was in the Colonial Hotel, and Mr. James E. Keelyn, general sales agent, was in charge.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY, Cleveland, was represented by Mr. L. Sands, general manager of the company. As usual, he worked early and late in receiving, and in explaining to his many callers the features of his company's line of instruments, magneto bells and desk sets. He showed a new lineman's testing set, for which several advantages are claimed.

MR. ROBERT L. MCOUAT, successor to Messrs. Varney & McOuat, of Indianapolis, Ind., entertained a large number of his friends in his quarters at the Colonial Hotel. Mr. McOuat has surrounded himself with a corps of thoroughly-experienced electrical workers, all well known to the trade, in the persons of Messrs. V. O. Grace, Oscar Carmon, F. M. Ross and Wm. Pogue.

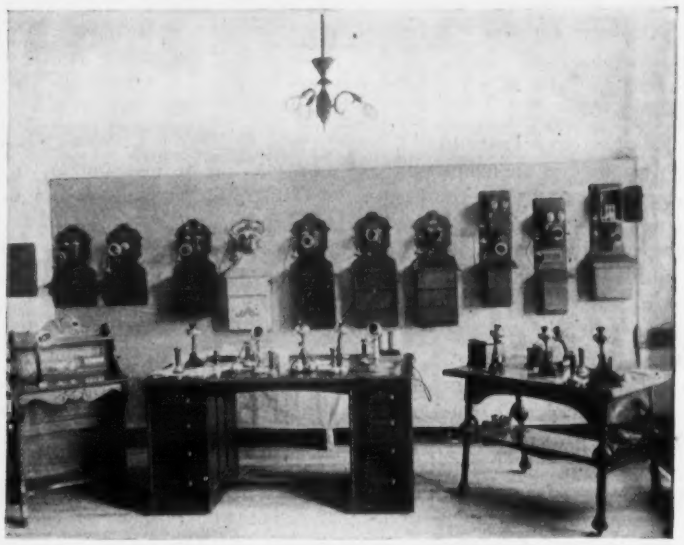
THE SWEDISH-AMERICAN TELEPHONE COMPANY, Chicago, had an exhibit of a switchboard embodying the central-energy and composite system. An extensive line of telephone instruments in various finishes and patterns were arranged on the walls. The president of the company, Mr. E. E. Overshiner, was in full charge of the exhibit, and was assisted by Mr. W. R. Lowe.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, was represented by Mr. L. G. Bowman, secretary and general manager, assisted by Mr. W. P. Booth. The company exhibited a special toll line switchboard and telephone combined; a regular toll line switchboard, equipped with bell as well as drops; the Western express 100-drop board and a special board for small exchange use.

B. F. STEWART & CO., Chicago, were represented by Messrs. B. F. Stewart, S. A. Duvall and J. G. Noland. An entirely new line of telephone specialties was exhibited at the Colonial Hotel. A sample of the new Century switchboard in full operation connected with several telephones in various parts of the room attracted much attention. A new magneto with automatic shunt and muffler for signaling was one of the specialties exhibited.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, Chicago, was represented by President Charles W. Farr, assisted by Mr. E. W.

WILLIAMS-ABBOTT ELECTRIC COMPANY.

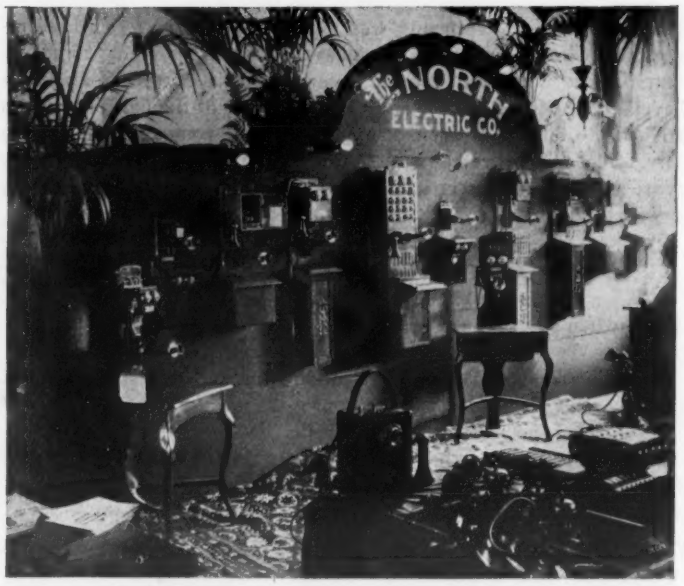


SWEDISH-AMERICAN TELEPHONE COMPANY.

STERLING ELECTRIC COMPANY.

EUREKA ELECTRIC COMPANY.

AMERICAN TELEPHONE COMPANY.



NORTH ELECTRIC COMPANY.

SOME OF THE EXHIBITS AT THE INDEPENDENT TELEPHONE CONVENTION.

Hurst. These gentlemen entertained numerous callers and exhibited bridging toll line instruments, having, besides, an attractive display of telephone supplies. A feature was made of a switchboard generator, capable of ringing through 70,000 ohms, and giving sufficient current to light an incandescent lamp. A novel test set was also shown.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, Cleveland, has lately gone into the manufacture of a general line of telephone instruments and parts. The company's new transmitter, showing a number of new features, was exhibited. Mr. Burt Hubbell, president of the company, had entire charge, and was assisted by Messrs. Kidney and Ambros. The officials of this company have had long experience in the manufacturing end of the business, and with ample capital and facilities, it will undoubtedly become an important factor in its new line.

THE VICTOR TELEPHONE WORKS, Chicago, had a well-arranged exhibit at the Colonial Hotel. A new design combination cross-connecting board with fuse terminals designed with special test clip for testing lines was exhibited; also a sample of the Victor standard straight metallic board having 150 numbers of express lines installed and 10 combination toll lines. A special feature is the operator's ringing and listening cam. A neat desk set equipped with the Victor standard switch hook having platinum contact points throughout attracted considerable attention. Mr. James S. Healey was in charge.

THE STROMBERG-CARLSON COMPANY, of Chicago, did not think it necessary to have an exhibit at the Cleveland Independent Telephone Convention, but the company was represented there by Mr. Stromberg, who did some profitable missionary work for his company. Thursday he chartered a private car over the Akron, Bedford & Cleveland Electric Railway, and took a number of the delegates down to Akron to inspect a new exchange which his company is installing there. The trip proved interesting as well as instructive, and many favorable comments were heard regarding this method of exhibiting goods.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., was represented by President F. B. Cook and General Manager W. E. Doolittle. These gentlemen exhibited for the first time a line of complete telephone instruments, the company having recently added these goods to its line of telephone apparatus. A feature of the new Sterling telephone is a complete transmitter arm and base made of pressed steel. The transmitter is so hinged to the arm that it remains in proper upright position, no matter at what angle the arm is placed. A complete switchboard, together with cable terminals, lightning arresters, strong current protectors and other apparatus were also exhibited.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, occupied a fine, large storeroom on the ground floor of the Electric Building, and had an exhibit which for completeness was unsurpassed. There were a number of different types of switchboards, including a sample of the central-energy, multiple and express self-restoring boards. There were also a number of telephone instruments of different types, patterns and finishes. The 1900 apparatus, which is entirely new and possesses a number of novel features, was prominently shown. The balance of the exhibit consisted of parts and specialties. The company was represented by President P. C. Burns, Assistant Treasurer J. G. Johnson, Mr. Eugene L. Brown, the Eastern manager, and Mr. S. J. Bear, Western manager.

THE ERICSSON TELEPHONE COMPANY, New York City, had an interesting exhibit of a complete exchange under working conditions with wires strung over poles and connected with instruments in all parts of the room. The Ericsson imported switchboard attracted much attention. This exhibit was in connection with that of the McIntosh-Huntington Company, Cleveland, agents for the first mentioned company. The latter concern had an extensive exhibit of telephone booths, line tools and practically all kinds of appliances used in construction work. A McIntosh sound-proof booth was arranged with city connection for the use of delegates. An exhibit of the wire made by John A. Roebling's Sons Company was also displayed. Mr. Ulysses G. Tingley, of that company, was present.

THE NORTH ELECTRIC COMPANY, Cleveland, occupied a prominent room, which was profusely decorated with palms and cut flowers, and was the centre of attraction for large crowds of interested delegates and spectators. The feature of the exhibit was a complete exchange working under practical conditions, including connections with a large number of instruments in various portions of the room, as well as a line to the company's factory. The factory was decorated for the occasion, and was visited by nearly all of the delegates during the week. Among other things were shown a central battery board, several toll line boards, desk sets, etc. A power generator with motor direct-connected was in operation, while another display which attracted attention was a magneto of the vintage of 1877. This was operated by pounding with the hand on a brass knocker, and, contrasted with the latest types of this instrument, demonstrated to a remarkable degree the advances that have been made in telephone construction. At the factory there was an extensive display of magneto coils. The new supervisory system shown on switchboards and instruments was favorably commented on. Much credit was due Mr. F. F. Sapp, who was in charge and who arranged the exhibit. The other officers of the company, Messrs. C. H. North and G. C. Steele, were also in attendance.

EXHIBIT OF THE ERICSSON TELEPHONE COMPANY.

EXHIBIT OF THE WESTERN TELEPHONE CONSTRUCTION COMPANY.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., had one of the most effective exhibits at the convention. It was essentially the same exhibit as that shown at the National Export Exposition at Philadelphia, and consisted of four cases of black walnut and bird's-eye maple containing samples of different styles of wire, cables and accessories for electric lighting, telephone, telegraph, fire-alarm and street railway service. Among the cable samples were new Standard cables, special new Standard cables with conductors up to 200 pairs and rubber-covered cables of various sizes. Samples of all kinds of rubber-covered wire, single and duplex, plain and braided, Marsh duplex wire, bare weatherproof and magnet wire; Degenhardt terminals, cast-iron lock nut and hard rubber tubular terminals; lightning arresters were also shown, together with a very fine sample, showing the suspension of an aerial cable by means of the one-piece malleable iron cable hangers. The managers of the New York, Chicago and

Philadelphia offices, Messrs. G. L. Wiley, J. R. Wiley and T. E. Hughes, respectively, were in evidence, together with Mr. Frank Clark Cosby of the home office at Pittsburg. These gentlemen were busily engaged in distributing samples of telephone cables and copies of their handbooks. Vice-President J. W. Marsh and Assistant General Manager P. H. W. Smith, of Pittsburg, joined the other representatives on Wednesday morning.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, had perhaps the most extensive exhibit of the convention. It exhibited specimens of its larger boards, which were held over in Cleveland en route to Baltimore, where the company is equipping an extensive exchange for the Baltimore independent company. These included the complete power switchboard and the nineteenth section of the Baltimore divided exchange multiple board. There were also two sections of a new universal board, which is the latest improvement in boards for comparatively small exchanges, where it is intended to install extensions later; since it is possible to change the board to the multiple system without material alteration. A desk switchboard for private exchanges with talking and signaling devices was in operation, connected with instruments in various portions of the exhibit. There was also a 100-line standard board with common battery for signaling and talking, which is going to the Lehigh Valley Railroad Company at Wilkes-Barre, Pa. All styles of instruments, including common battery talking, local battery, magneto generators, etc., were shown; also numerous parts showing details of construction. In connection with the main exhibit was a handsomely-furnished retiring room, in the centre of which was a large table containing samples of the details and parts of the multiple switchboard. The force in charge consisted of Messrs. M. G. Kellogg, Kempster B. Miller and Franz J. Dommerque, of the engineering department; W. A. Taylor and G. L. Burlington. The latter designed and arranged the exhibit, and was the recipient of many compliments.

The Electric Storage Battery Company's Convention.

The annual convention of the executive staff of The Electric Storage Battery Company was held at the Hotel Walton, Philadelphia, from Monday, June 4 to Thursday, June 7, inclusive. Over forty delegates from the various departments were present. The branch offices of the company were represented by Mr. Albert Taylor, W. H. Palmer, W. O. Knudsen, J. M. McLean and E. L. Reynolds, of the New York office; Mr. Frank H. Clark and R. B. Daggett, of the Chicago office; Mr. Frank J. Stone and Philip W. Davis, of the Boston office, and Mr. R. C. Hull, of the Baltimore office.

Monday morning was devoted to an inspection of the works of the Storage Battery Company, at Nineteenth Street and Allegheny Avenue, by the visiting members, after which they were grouped in front of the office building, when a photograph was taken, which is unique, inasmuch as it probably represents more storage battery knowledge than was ever gotten together before in one "bunch." After being photographed, the party adjourned to the spacious dining-rooms on the fourth floor of the main factory building, where luncheon was served, and the fact discovered that "Chloride Accumulators" were not the only good things turned out by the Storage Battery Company.

At 3 o'clock the convention was called to order at the Hotel Walton, by Mr. Herbert Lloyd, vice-president and general manager, in a neat speech of welcome, which was received with applause. The various papers which were read before the convention during its sessions covered a wide range of subjects in connection with the business of The Electric Storage Battery Company, and were each followed by a discussion in regard to the points involved, in which the writer of the paper answered any questions that might be put to him in detail. The papers were as follows:

The Sales Department, by Mr. Chas. Blizard; Preliminary Engineering, by Mr. J. Lester Woodbridge; Results Obtained from Installations, by Mr. Hugh Lesley; The Relation of the Construction Department to the Sales Department, by Mr. Jos. Appleton; Some Details of Construction Department Methods. by Mr. R. H. Klauder; Characteristics of Standard Cells, by Mr. Bruce Ford; The Use of Boosters, by Mr. J. B. Entz; The Law of Contracts, by Mr. Aug. B. Stoughton; Street Railway Business in New England, by Mr. Frank J. Stone; The Application of Chloride Accumulators in Isolated Plants, by Mr. Albert Taylor; The Operation of Batteries in Connection with Long Distance, High Speed, Railway Service, by R. C. Hull.

The social features of the convention were not neglected, and consisted of a planked shad dinner at Washington Park, on Monday evening, at which there were over 40 guests. This was followed by a dinner of 26 covers, at the Germantown Cricket Club, Manheim, on Tuesday evening, at which an elaborate menu was discussed to the enlivening strains of music, and interspersed with song and story. On Wednesday the delegates were given a reception by Mr. Herbert Lloyd, at his residence, High Street, Germantown, and on Thursday evening the proceedings pleasantly terminated by an informal dinner at the Hotel Walton. The visiting gentlemen, especially the New York contingent, are now beginning to wonder in a dazed sort of way, where on earth they ever gathered the impression that Philadelphia was a "slow town."

The *esprit du corps* of the employees of The Electric Storage Battery Company, probably more than any other one thing, accounts for the magnificent results that have been produced by them in the past, and makes it easy to predict the future.

Desk Telephone.

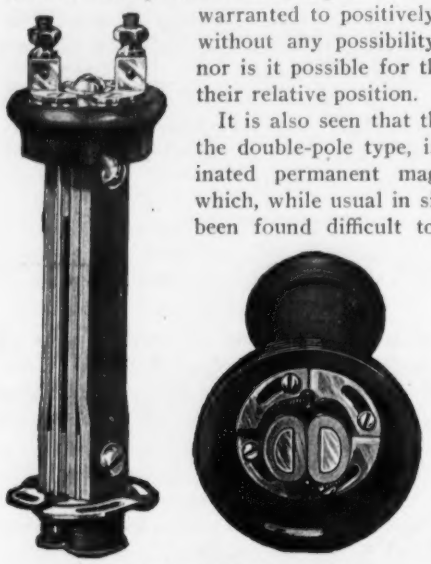
The accompanying illustration shows one of several types of desk telephones made by the Connecticut Telephone & Electric Company, Meriden, Conn., and which are applicable both for exchange and interior work. The standard is fitted with a flat hook spring instead of the spiral spring usually found on this class of instrument, which renders the action of the instrument more reliable. The transmitter is so mounted that it is simply necessary to loosen two screws in order to remove it. The cords terminate in binding screws mounted on an insulated block in the base so that it is not necessary to unsolder the cord connections when removing or renewing a cord. The instruments are fitted with either single or double-coil receivers, long-distance transmitters and platinum contacts. The induction coil is mounted in the base. Another similar instrument has the induction coil mounted on terminal block.

DESK TELEPHONE.

A New Bipolar Telephone Receiver.

We illustrate herewith a telephone receiver which is claimed to possess some radically new features. The pole-pieces, it will be noted, are of a peculiar shape, the object of this being that they shall conform to the natural magnetic path and produce a strong, even pull on the diaphragm. This construction, it is stated, was arrived at after a careful study of the magnetic field.

Another feature is the method allowed for adjustment. Should it be desired to increase or decrease the distance between the diaphragm and the pole-pieces all that is necessary after loosening the four binding screws (in the plate around the coils) is to rotate the lower tail-piece; this will cause the inclined surfaces to engage and the magnetic poles to approach or recede from the diaphragm. When the adjustment desired is obtained, it can be firmly secured again by the binding screws. The posts for attaching the cord are of a new type, and are warranted to positively lock the tips of the cord without any possibility of their working loose; nor is it possible for the posts to turn or change their relative position.



FIGS. 1 AND 2.—BIPOLAR RECEIVER.

It is also seen that the instrument, although of the double-pole type, is constructed with a laminated permanent magnet, a desirable feature which, while usual in single-pole instruments, has been found difficult to incorporate into bipolar receivers.

The above are some of the features that will be readily noted as improvements, but there are other points equally important in the construction of a good receiver that are not so noticeable upon casual inspection. The proportioning of parts has received careful thought; the windings on the spools, the thickness and diameter of the diaphragm and the strength of the permanent magnets are all in proper proportion and relation to one another, the result being a very efficient receiver with an exceptionally pure and clear tone. The Holtzer-Cabot Electric Company, Brookline, Mass., are putting the instrument described on the market.

The Queen-Schultz Chronoscope.

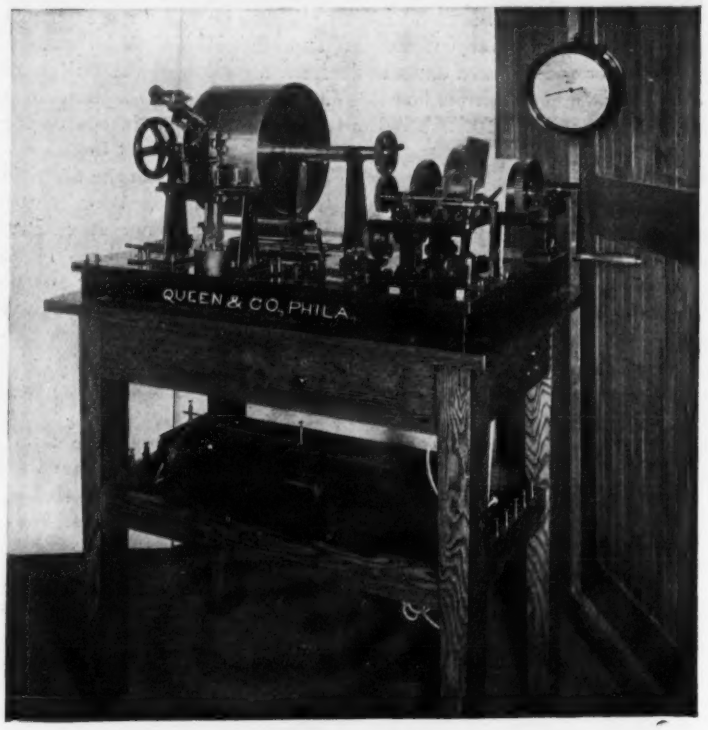
The Queen-Schultz chronoscope is a modification of the chronoscope originated by Captain Schultz, of France, for the purpose of determining exceedingly small intervals of time. This form was particularly designed for measuring the velocity of projectiles while traveling along the barrel of a gun.

A drum, one metre in circumference, and covered with a coating of lampblack, is driven by the means of a clock movement and weight, so as to revolve once per second and at the same time slowly advance longitudinally. In front of the drum, mounted on a support and actuated by two magnets, is a standard tuning fork, vibrating 250 times a second; on one limb of this fork is a quill which traces a line on the blackened surface of the drum, and therefore will record 250 complete vibrations for every revolution of the drum.

A telescope with micrometer is also attached to the support fork, and each vibration of the fork, traced on the drum in form of a curve, can be subdivided into 1000 parts, thus allowing readings to be made to 1/250,000 of 1 second. On the support with the tuning fork is a small pointer which traces a straight line on the drum. This pointer has an electrical connection with an accurate chronometer which at every half-second closes the circuit and causes the pointer to make a succession of records on the revolving drum. These marks serve as starting points to count the number of vibrations of the tuning fork, and to check them up every half-second.

In order to measure the velocity of projectiles, the gun must be fitted along its bore with special electrical circuit breakers, usually placed one foot apart. Each circuit breaker is so constructed that the current is interrupted as the projectile passes, but is made again before the projectile reaches the next breaker one foot further on.

These breakers, with appropriate battery, are all in one circuit with the primary of an induction coil. One terminal of the secondary of the coil is grounded to the frame of the chronoscope, while the other terminal consists of a fine point near the blackened surface of the drum. Therefore, when the primary circuit is opened by the first circuit breaker along the bore of the gun, the spark induced in the secondary of the induction coil jumps from the points to the revolving drum, leaving a distinct mark on the blackened surface. As the next circuit breaker in the gun is passed, the spark again passes to the



CHRONOSCOPE.

drum, and this operation is repeated for every breaker along the gun bore. Thus on the drum, alongside of the indications made by the tuning fork, will be recorded a succession of spots at certain distances from each other. The time elapsing between any two of these spots can be calculated directly from the record which the tuning fork made, and thus the time (measured to the 1/250,000 part of a second) taken by the projectile in passing a known distance along the gun barrel calculated.

Burr Come-Along.

The Burr Manufacturing Company, Cleveland, Ohio, is putting upon the market a device intended primarily for a hoist. It has been found, however, to be so admirably adapted to linemen's use as a "come-along" that it has been adopted by several companies for this purpose, and the Burr Manufacturing Company is now making it

COME-ALONG.

in small sizes, such as can be carried in linemen's pockets. An examination of the cut herewith will show the device to be constructed upon correct mechanical principles. It is very popular with the linemen who are using it, and is certain of general adoption as soon as it becomes better known.

The Works of the E. W. Bliss Company.

The accompanying half-tone is an interior view of the main works and the erecting shops of the E. W. Bliss Company, press and die makers, of Brooklyn, N. Y., as it will appear after the alterations now under construction have been completed. The buildings will probably be finished by the latter part of September. They will be a continuation of the six-story building on Adams and John streets, and will be

50 ft. on Adams Street by 157 ft. on Plymouth Street, where they join the original machine shop on Pearl Street.

These buildings will be equipped with the most modern appliances and labor-saving machinery, and, when completed, will increase the company's output capacity about one-third. A large order for machine-shop tools, to be delivered when the buildings are ready, has already been placed. The Bliss Company has worked to a disadvantage for the last two years, from the fact that it could easily sell a quarter more goods than it had the facilities to produce.

INTERIOR VIEW OF MAIN WORKS OF E. W. BLISS COMPANY.

Plans are also nearly ready for a new foundry to be erected on 15 lately acquired lots on Water, Jay and Plymouth streets. This foundry will be fitted up in the most up-to-date manner, and will increase the foundry capacity fourfold. For months past, not an order could be taken for outside foundry work. In fact, it has taken all its own foundry capacity, and largely that of four other foundries to supply the demands of the machine shops of the Bliss Company.

A novel feature of the buildings at Adams and Plymouth streets will be the location of the offices on the sixth floor, far above the noise and dust of the street, and nearly on a level with the roadway of a bridge, which crosses 25 or 30 ft. from the corner of the building.

When all of the new buildings will have been completed, the Bliss Company will have a factory floor space of over 300,000 sq. ft., making it the largest factory in the world for the manufacture of presses, dies and special machinery for the working of sheet metals.

Automatic Gear-Cutting Machine.

The gear-cutting machine illustrated in the accompanying cut is, as its name implies, automatic in all of its movements. After being set and started the cutter feeds through the gear blanks and returns rapidly to the starting point; the dividing wheel then rotates to the exact place of the next tooth, and the operation is repeated indefinitely without further attention from the operator.

The dividing wheel, which is made in two parts, is by improved processes made extremely accurate, the final corrections being made under a microscope. The wheel is actuated by a steel worm with compensating devices for maintaining the original accuracy, and is protected from dust and injury by a close-fitting iron shield. The actuating worm runs in an oil box.

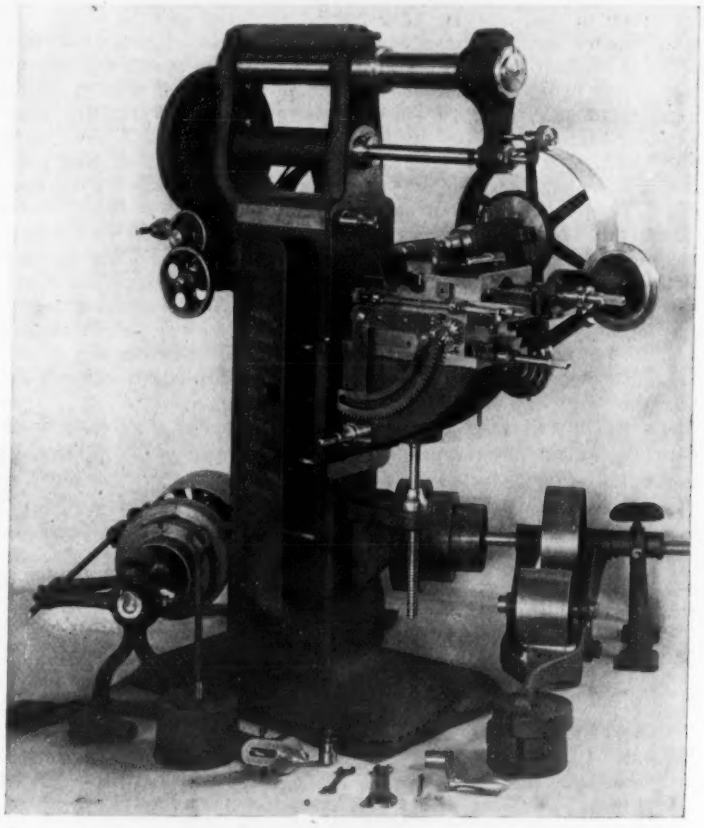
The machine contains several original devices to facilitate accuracy and efficiency. A centering device fixes the exact centre of the cutter with reference to the knee or other parts. A dial, reading to thousandths of an inch and connecting with the screw, enables the cutter to be set to the correct depth without using line or depth gages.

The quadrant which sustains the cutter carriage at any required angle, is graduated in degrees, and the cutter can be fed at any angle through an arc of over 90 degs., running equally well in the vertical as in the horizontal position. The cutter carriage can also be set at an angle either way in a horizontal plant, and has a graduated scale defining the angle. The automatic feed is so arranged that the feed cones and the feed belt, while always running in one direction, yet feed both ways. The recovering motion is 40 times faster than the working motion.

There is no reversal of the driving parts, and consequently no shock, the whole movement being smooth and practically noiseless even at high speeds. The dividing mechanism is driven by belt, which bears mostly on a loose pulley, but partially on a fast pulley by its side, the amount on the fast pulley being graduated by adjustable fingers. An adjustable rim rest is provided which prevents chattering. The working parts are in the strongest position when cutting the largest gears.

The cutting spindle has a long tapering centre hole to receive the cutter arbor, thus allowing any number or size of cutter arbor to be used. The arbor has an outer centre support which not only prevents vibration, but allows smaller cutters to be used than is possible with a solid spindle. A radial clutch upon the feed screw connects and disconnects the feed; when disconnected the machine can be worked by hand, thus enabling the operator to make adjustments and assure himself that all the machine movement are properly timed before making the automatic connection. It also allows the gear blank to be rotated to any position for examination after one or more teeth have been cut.

The locking device makes but one revolution, no matter what the number of teeth to be cut may be; the locking bolt having but one seat in the disk, necessarily locks always in the same place, thus preventing mistakes in dividing. A second disk, secured to the locking disk and fixed to the worm shaft, is laid off in degrees, and can be rotated between the dividing wheel and the gear blank while all other movements are stopped; the "set over" for bevel gears is thus fixed with accuracy and certainty. The chain gears—50 in number—are fitted in a wooden case occupying the body of the machine, each in its own compartment.



AUTOMATIC GEAR CUTTER.

An overhanging removable arm for supporting the outer end of the mandrel enables strings of gear wheels to be cut more perfectly than when supported at one end only. A centre, with dog attached and fitted to the spindle of the machine, enables gear blanks after being made ready in the lathe to be transferred without removal from the mandrel to the gear-cutting machine, thus obviating numerous special mandrels. The machine described is manufactured by the Becker-Brainard Milling Machine Company, Hyde Park, Mass.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was extremely dull last week, and there was practically complete stagnation in speculation. It is indeed many months since the amount of commission house business has been so low. Investment values are firmly held, and the demand for the better class of income-yielding securities is good, but by no means active. Railroad earnings in some cases show decreases from last year's records, and are likely to be influenced by the decreased activity of business and the prospect of reduced crops. The loan market was quiet, with a tendency toward lower prices. Time money was freely offered all the week at 3 per cent for 30 to 90 days, and 3½ to 4 per cent for longer periods. Call money was quoted at 1¾@2 per cent, there being a good supply during the week. The supply of mercantile paper was small, and the market dull, the rates being based on 3½@4 per cent for double names. In the market for industrial stocks the tone ranged from dullness to heaviness, with renewed declines in Federal Steel, and others of the industrial group. In the list of electric stocks General Electric and Western Union alone show net advances at the close of the week. General Electric closed at 131½, ex dividend, the net gain being ½ point. The sales of this stock were 1640 shares. Western Union closed at 80¼, with a net gain of ½ point. The quarterly report of the company was issued during the week, together with an advance (estimated) statement of the year's business. A summary of these reports will be found elsewhere in this department. Tractions without exception closed with net losses. Brooklyn Rapid Transit closed at 67½, the net loss being 1¼ points; the sales of this stock were 23,050 shares. Metropolitan Street Railway closed at 152¾, with a net loss of 2¼ points, and Third Avenue's closing price was 108½, the net decline being 3 points. Among the outside securities a few stocks made net gains during the week, but as a whole no improvement was shown in the general conditions prevailing in that market. The public continues to hold aloof, and even traders seem to have come to the conclusion that a waiting policy is the best one. In the miscellaneous list of stocks the following closing prices are quoted: Electric Boat, 15; do., pfd., 33; Elec. Vehicle, 20; do., pfd., 70 asked; General Carriage, 5¾; Ill. Elec. Vehicle Trans., ¾; New England Elec. Trans., 3¼; New York Elec. Vehicle Trans., 7¼; Otis Elevator, 29¼; do., pfd., 88; Telegraph, Telephone & Cable of America, 4. In the inactive list Hudson River Telephone is quoted at 120; New York & New Jersey Telephone, 170. In Philadelphia the closing quotations were as follows: American Railways, 5⅜; Brooklyn Gas & Elec., 16; Elec. Storage Battery, 75; do., pfd., 80; Electric Company of America, 9⅛; General Electric Automobile, ⅛; Philadelphia Electric, 3⅝. The Boston market closed heavy. Telephone rights are quoted at 7⅜; American Telephone, 144; Bell Telephone, 301; Erie Telephone, 100; Gen'l Elec. pfd., 137 asked; Mex. Telephone, 1⅞; Westinghouse Elec., 44; do., pfd., 62½.

RAPID TRANSIT BONDS.—Comptroller Coler of New York City has advertised for proposals for bonds and stock for various public enterprises, including $1,000,000 corporate stock of the City of New York for the construction of the Rapid Transit Railway.

AUGUSTA RAILWAY BONDS.—The entire issue of $1,000,000 5 per cent first mortgage bonds, of the Augusta Railway & Electric Company, Augusta, Ga., has been underwritten by a syndicate of Baltimore capitalists.

HARTFORD RAILWAY MORTGAGE.—The entire property of the Hartford Street Railway Company, Hartford, Conn., will be mortgaged for $3,000,000, to cover which 4 per cent bonds will be issued.

WESTERN UNION STATEMENT.—The statement of the Western Union Telegraph Company for the quarter ending June 30 shows the following results, the figures for 1899 being actual, while those for this year are partly estimated:

	Est., 1900.	Act'l, 1899.	Changes.
Net revenues	$1,700,000	$1,652,729	Inc. $47,271
Interest on bonds	225,000	224,273	Inc. 727
Balance	$1,475,000	$1,428,456	Inc. $46,544
Dividends	1,216,996	1,216,988	Inc. 8
Surplus	$258,004	$211,468	Inc. $46,536
Previous surplus	8,298,224	7,855,459	Inc. 442,765
Total surplus	$8,556,228	$8,066,927	Inc. $489,301

The company's fiscal year ends with the June quarter. By combining the four quarterly statements the following results are shown for the fiscal year ending June 30, the figures this year being partly estimated, while those for the previous year are actual:

	1900.	1899.	Change.
Net revenues	$6,264,438	$5,868,732	Inc. $395,706
Interest on bonds	907,158	897,092	Inc. 10,066
Balance	$5,357,280	$4,971,640	Inc. $385,640
Dividends	4,867,979	4,867,948	Inc. 31
Surplus	$489,301	$103,692	Inc. $385,609
Previous surplus	8,066,927	7,963,235	Inc. 103,692
Total surplus	$8,556,228	$8,066,927	Inc. $489,301

DIVIDENDS.—The Boston Elevated Railway Company will, in accordance with the provisions of the lease, pay to the holders of preferred stock of the West End Street Railway Company, a dividend rental of $2 per share. This applies to holders of stock on July 2. The Western Union Telegraph Company has declared the regular quarterly dividend of 1¼ per cent. The Boston Electric Light Company will pay a regular quarterly dividend of $2 per share, on July 14. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable July 2. The Safety Car Heating & Lighting Company has declared a quarterly dividend of 2 per cent, payable July 2. The Hestonville Passenger Railway Company, Philadelphia, has declared a dividend of $1.50 on preferred stock and $1 on common stock, payable on July 1.

Commercial Intelligence.

THE WEEK IN TRADE.—In summarizing the state of trade during last week Bradstreet's says, measured by recent records and recollections of business activity, the present between-seasons dullness seems specially marked, and the reactionary movement of prices makes trade look worse than it really is. Judged by such indicators as railroad earnings and the statistics of foreign trade, the volume of business doing is considerably larger than a year ago, when it will be recalled trade was cheerfully active. It is true bank clearings are considerably smaller than last year, taking the country as a whole, but last year's clearings undoubtedly included much of a speculative character, almost wholly absent this year, and yet, outside of the metropolis, bank clearings are heavier this year than last. Lower prices for iron and steel have not met expectations of causing a reduction in output. Rails and structural steel are firm, but there is talk of reduction in prices for the better product. Other metals are, on the whole, dull and weak. Copper is firmer in European markets, but unchanged here. The quotations at New York are, for carloads, 16⅜@16½c. for Lake Superior ingot; 16⅛@16¼c. for electrolytic, and 16⅛c. for casting. The production and the export of copper for the month of May are reported by Statistician Stanton as follows: Produced by the United States reporting mines, 19,282 tons; by outside sources (estimated), 3,400 tons. Exports, 13,997 tons, all in tons of 2,240 pounds refined copper. The gross railway earnings of 117 roads for May, reported to Bradstreet's, aggregate $55,000,000, an increase of 10.6 per cent over May a year ago, and following progressive increases in that month for five years past. For the five months earnings aggregate $270,000,000, 14.8 per cent heavier than a year ago. That favorable conditions are still continuing may be judged from the fact that gross earnings of 66 roads for the first week of June aggregate $8,598,000, an increase of 8.2 per cent. Failures for the week numbered 180, as against 184 the previous week, and 50 during the same week last year; 207 in 1898 and 226 in 1897.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical materials from the port of New York for the week ended June 9: Argentine Republic—30 cases electrical machinery, $1,914. Antwerp—9 packages electrical machinery, $2,993. Bristol—41 cases electrical machinery, $4,500; 52 electric cable reels, $6,945. British West Indies—35 packages electrical material, $111. Brazil—165 packages electrical material, $10,002; 4 packages electrical machinery, $3,100. Manchester—6 cases electrical material, $110. Brussels—1 case electrical machinery, $418. Central America—27 cases electrical material, $714. Chile—12 packages electrical material, $449. Cuba—26 packages electrical material, $474. Ecuador—1 case electrical material, $37. Hamburg—36 cases electrical material, $1,260. Havre—9 packages electrical material, $985. Liverpool—297 packages electrical machinery, $23,392; 11 cases electrical

material, $1,380. London—130 packages electrical machinery, $12,-221; 107 packages electrical material, $4,578. Margate—8 cases electrical machinery, $3,100. Manchester—6 cases electrical material, $1,500; 7 packages electrical machinery, $21,165. Peru—12 cases electrical machinery, $2,280; 13 packages electrical material, $2,073. Puerto Rico—19 packages electrical material, $377. Santo Domingo —7 packages electrical material, $444. Southampton—2 packages electrical material, $950; 70 cases electrical machinery, $1,041. U. S. Colombia—3 cases electrical material, $71. Venezuela—26 packages electrical material, $53. For the week ended June 16 the exports were: Argentine Republic—17 cases electrical machinery, $3,300; 57 cases electrical material, $5,326. Antwerp—33 packages electrical machinery, $2,361. Alexandria—32 packages electrical machinery, $1,359. British East Indies—13 packages electrical material, $482: 15 packages electrical machinery, $1,025. Brussels—5 cases electrical material, $240. British West Indies—16 cases electrical material, $551. British Australia—93 packages electrical machinery, $15,591; 96 cases electrical material, $10,287. Bremen—10 cases electrical machinery, $800. Brazil—6 cases electrical material, $292. Cuba—1 case electrical material, $58. China—1 case electrical material, $53. Christiana—1 case electrical material, $16. Ecuador—26 packages electrical material, $255. Florence—10 packages electrical material, $1,298. Glasgow—136 cases electrical machinery, $19,374; 6 cases electrical material, $750. Genoa—4 cases electrical material, $94. Havre—1 case electrical material, $3,250; 152 packages electrical machinery, $30,779; 6 cases electrical carriages, $7,250. Hamburg—4 packages electrical machinery, $800; 80 packages electrical material, $4,953. Japan—191 cases electrical machinery, $29,-451; 341 cases electrical material, $13,778. Liverpool—39 cases electrical material, $6,275; 69 cases electrical machinery, $7,938. London —131 packages electrical machinery, $17,464; 95 packages electrical material, $12,843; 4 automobiles, $1,200. Lisbon—150 packages electrical railway material, $9,034. Mexico—33 cases electrical material, $6,178; 12 parts automobile, $2,525; 1 case electrical machinery, $23. Marseilles—135 cases electrical material, $11,515. Malta—2 cases electrical material, $36. Newcastle—2 cases electrical material, $120. New Zealand—1 case electrical machinery, $112; 3 packages electrical material, $68. Naples—9 packages electrical material, $1,200. Peru—10 cases electrical material, $420. St. Helena—70 packages electrical material, $1,015. Venezuela—3 packages electrical material, $51.

INDUSTRIAL EXHIBITS.—The Philadelphia Bourse, occupying a block on Fourth, Fifth, Market and Chestnut Streets, Philadelphia, is the first "General Exchange" in the United States. The Bourse consists of three distinct features: First, the General Exchange; second, the Exhibition Department, and third, the offices. The Exhibition Department is devoted entirely to machinery, mechanical appliances, and heavy raw materials. There is about 18,000 square feet of space devoted to the display of goods, and most of the exhibitors arrange to have a representative located on the space with their exhibit, or arrange with some one already located in the department to look after their line in connection with others of a similar but non-competitive character. Every opportunity is given to show all classes of machinery in operation, whether the motor power be steam, gas, water or electricity, the charge for power being simply the cost of production, there being no desire to make profit. The department is under the charge of Mr. Wm. H. Rogers, who for 25 years was superintendent of the machine-tool works of Bement, Miles & Co. Mr. Rogers' duty is to give to exhibitors, as well as to all visitors, information that they may desire of a mechanical nature. Letters are frequently received from all parts of the country asking for information as to where certain lines of goods can be obtained, and the best methods of obtaining certain mechanical results, such correspondence being answered without charge, bearing in mind, whenever possible, the interests of the various exhibitors.

CLEVELAND TELEPHONE COMPANY.—At the annual meeting of the stockholders of the Cleveland Telephone Company, a part of the Erie system, held last week, it was decided to issue $1,000,-000 in order to provide for contemplated improvements to the system. The capital stock of the company has been $3,000,000 and it was increased to $4,000,000. The company contemplates the erection and installation of nine additional exchanges, several of which are already in process of construction. The company also proposes to lay from 15 to 20 miles of additional conduit. The following board of directors was elected by the stockholders: Charles E. Adams, Lowell; Charles J. Glidden, Lowell; Frank F. Hickox, Cleveland; Alfred B. Hough, Cleveland; John E. Hudson, Boston; Lee McBride, Cleveland; Wm. J. McKinney, Cleveland; James P. McKinstry, Cleveland; Thomas Sherwin, Boston; Edward P. Williams, Cleveland; Edward P. Wright, Cleveland. The board of directors organized with the following officers: President, Charles J. Glidden, Lowell, Mass.; vice-president, J. P. McKinstry; treasurer, Charles A. Grant, Lowell; secretary, George P. Perham, Lowell, Mass. The Eastern stockholders present were Charles E. Adams, John C. Burke, Frank A. Cutting, Charles J. Glidden, James H. Mills, J. W. C. Pickering, John B. Stauffer, George B. Perham, Charles S. Tuckerman.

THE VARLEY DUPLEX MAGNET COMPANY will be incorporated this week under the laws of New Jersey, with a capital stock of $3,000,000, divided into $500,000 of 6 per cent cumulative preferred shares, and $2,500,000 of common shares. The names of the various directors and subscribers to all the new stock are the same as those interested in the former company, which has been dissolved. The new company will embark in a wider range of work; it will draw its own wire and the plant in Jersey City will be increased to about ten times the present capacity. The parent company will operate a number of businesses engaged in the manufacture of magnets, including several in foreign countries. All the magnet-winding machinery, wire-drawing and covering machinery, etc., will be designed and constructed at the works of the parent company in Jersey City. The names of the various directors and subscribers to the company are as follows: Robt. Varley, president and director; John Scott, vice-president and director; Robt. D. Miller, treasurer and director; Wm. J. Varley, secretary and director; John S. Brown, director.

COMBINATION OF ELECTRIC VEHICLE INTERESTS.—The circular sent to the stockholders of the Electric Vehicle Company, calling a meeting for June 20, in Jersey City, states that it is the intention of the directors to consolidate the Columbia and Electric Vehicle Companies and the New Haven Carriage Company into one concern, and then the Electric Vehicle Company will absorb the consolidation. It is stated that the Electric Vehicle Company now owns one-half of the capital stock of the Columbia and Electric Vehicle Company and it proposes to acquire the other half by the new issue of stock. The latter company owns one-half interest in the New Haven Company. As already announced, the stockholders of the Electric Vehicle Company will vote upon the question of increasing the capital stock of the company from $12,-000,000 to $18,000,000.

THE OTTAWA ELECTRIC COMPANY, Ottawa, Ont., has just closed a contract with the Stilwell-Bierce and Smith-Vaile Company, Dayton, Ohio, for the wheel plant for the new station at the Chaudiere Falls, Ottawa. This contract, which amounts to $30,000, provides for units of 1150-hp each, and when the electric plant is all arranged for and installed, it will make one of the most up-to-date electric-light stations in America. Other large contracts are soon to be awarded by the company. Three generators, each with a capacity of 15,000 lights, will be installed. The cost of the station complete will be in the vicinity of $300,000. The work of construction is being pushed with all possible speed, in order to have the station ready for operation for next winter's business.

SALE OF THE STEPHENSON CAR WORKS.—On June 12, the John Stephenson Car Works, at Elizabeth, N. J., were sold at auction to Joseph C. Willetts and Adolph Wimpfheimer, of New York, who represented the creditors' committee. A total of $226,283 was realized; $177,000 being for the plant and $49,283 for material. The original cost of the works and material was $593,960. The works were established in 1896. The plant has been in the hands of a receiver for a year or more. It is stated that the works will be reopened by the new owners, who will continue the same business.

ELECTRIC PUMP FOR ENGLAND.—The Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, are preparing to make the shipment to England of what is said to be one of the largest electrically-driven pumps ever exported from this contry. The pump is a vertical triplex electric one, and will have a daily capacity of 3,500,000 gallons. It will be driven by a 100-hp motor, and fitted with an automatic starter. The pump, which, with electrical equipment is valued at $10,500, has been ordered by Frederick Nell, of 97 Queen Victoria Street, London, S. W.

WESTINGHOUSE APPARATUS FOR GENEVA.—The information comes from Pittsburg to the effect that the Westinghouse Electric & Manufacturing Company has received the contract for the equipment for the new traction system in Geneva, Switzerland. About 130 cars will be equipped with Westinghouse motors and other apparatus made in Pittsburg. The contract was given by the Compagnie Genevoise des Tramways Electrique.

THE ELECTRIC FAN IN INDIA.—A correspondent in India writes: "There is an immense sale for electric fans at present. Recently the eight rooms of the High Court of Calcutta were equipped, as well as the private chambers of the Justices; this being an indication of the triumph of the electric fan over conservatism."

ENGINE FOR SPAIN.—Westinghouse, Church, Kerr & Co., of New York, have secured a Spanish order for a 200-hp vertical compound engine, which will be utilized in the electric-light plant at Barcelona. The engine will be built at the East Pittsburg works of the Westinghouse Machine Company.

Special Correspondence.

ENGLISH NOTES.

London Office of ELECTRICAL WORLD AND ENGINEER,
June 8, 1900.

ELECTRIC LAUNCHES ON THE THAMES.—It has been a matter of comment for some time that the River Thames is at present entirely unused as a method of transport in London, though its natural advantages are great, and an excellent business could undoubtedly be done. Paris, which resembles London to the extent that it has a river—the Seine—running through its busiest centre, has a large flotilla of boats, which run at very few minutes' interval up and down and on both sides of the river. The *Daily Mail* now proposes that a flotilla of electric launches would be eminently suitable for river transport, and if the London County Council would adopt some such scheme, it would undoubtedly be warmly commended by the public, and the boats would do a splendid business.

ELECTRIC LIGHTING IN LONDON.—One of the most striking features to a stranger in London is the comparatively small amount of public electric lighting—that is, street lighting. Many complaints have been made, and it is now a subject for universal congratulation that St. Martin's Parish (our American reader must remember that London is divided up into a large number of parishes, each one of which has absolute control of the streets in its territory), which is situated in the vicinity of Charing Cross, Trafalgar Square, Leicester Square—haunts all well known to the visitor—has just completed and put in service an elaborate system of electric arc lighting for public purposes. In all, 97 arc lamps have been erected in the Haymarket, Leicester Square, Trafalgar Square, Cockspur Street, Charing Cross, Whitehall, Northumberland Avenue, St. Martin's Lane, the Strand, and a number of other streets in the vicinity. Very wisely the parish decided not to erect a generating station, though the subject was duly discussed, but have made a contract with the Charing Cross and Strand Electricity Supply Corporation to furnish the necessary current. The lamps are 10-ampere, open arc lamps of 1000 nominal candle-power each, and are suspended on ornamental poles of neat design. The cables for the transmission of the current are all underground, and were made by Callenders Cable Company, being pulled into Doulton earthenware ducts. The lamps were made by Messrs Oliver & Company, of Woolwich, who have had a large experience in furnishing lamps to many of the large railway companies of Great Britain.

General News.

THE TELEPHONE.

RICHMOND, VA.—The Chesapeake Telephone Company has completed its line between Hampton and Yorktown.

SHEBOYGAN, WIS.—The Wisconsin Telephone Company has planned extensive improvements in its system in this city.

NEENAH, WIS.—The Common council has granted a franchise to the Wisconsin Telephone Company to construct an underground wire system.

RACINE, WIS.—The crossing of a telephone wire and trolley wire caused a panic in the telephone exchange and burnt out nearly 200 telephones.

BALTIMORE, MD.—The Cumberland Valley and Maryland Telephone companies will connect by telephone all the mountain resorts about Pen-Mar.

GREENFIELD, IND.—The Citizens' Telephone Company has been incorporated. Capital, $10,000. Incorporators: W. Finnell, T. B. Piper, C. Kingan, all of Greenfield.

MARSHFIELD, WIS.—A movement is on foot here to organize a company to build a telephone line connecting Grand Rapids, Marshfield, Wausau and intermediate towns.

NEW YORK, N. Y.—The Knickerbocker Telephone Company has opened an office in Brooklyn. Work is being pushed on the construction of its lines in Queens Borough.

GRANVILLE, N. Y.—The Granville Telephone Company of Granville, Washington County, has filed a certificate of the increase of its capital stock from $10,000 to $30,000.

COLUMBIA, S. C.—The South Carolina Telephone Company, of Columbia, announces that it is now ready for business. Subscribers will not be asked to sign annual contracts.

GLENN SPRINGS, S. C.—The Glenn Springs (S. C.) Telephone Company, capital $500, has been commissioned. The company proposes to erect telephone lines to outside points.

VANDALIA, ILL.—The Farina & Vandalia Telephone Company, of Farina, has been incorporated. Capital, $2,500. Incorporators, Thomas Zinn, Charles T. Wade, Charles W. Maxon.

MASON CITY, IA.—The Greene & Western Telephone Company has been organized here. Capital, $150,000. Incorporators: A. Kime, W. J. McAllister, H. E. Soesbe, all of Mason City.

HARTSVILLE, IND.—The Hartsville Telephone Company has been incorporated. Capital, $2,500. Incorporators: J. W. Anderson, J. W. Smith, F. J. Beck, J. L. Towson, all of Hartsville.

WILLS POINT, TEX.—The Excelsior Telephone Company, of Wills Point, has been chartered. Capital, $6,000. Incorporators: W. M. Mitchell, F. M. Kidder, W. M. Mitchell, Jr., all of Wills Point.

COVINGTON, IND.—The Shawnee Telephone Company, of Covington, has been incorporated. Capital, $3,000. Incorporators: B. Brown, J. H. Meeker, H. H. Stroder, T. Purdue, all of Covington.

FARMLAND, IND.—The Farmland Telephone Company has declined overtures by the Central Union Telephone Company, and will co-operate with the Eastern Indiana Company along independent lines.

LA CROSSE, WIS.—The Wisconsin Telephone Company has commenced the work of laying its wires underground in the business district of the city. It will put in about three miles of underground conduits.

LA PORTE, IA.—The La Porte Telephone System of La Porte, Ia., has been incorporated. Capital, $2,500. Incorporators: J. C. McGohran, G. M. Nesbit, E. G. Leffler, S. J. Tedford, C. F. Bennett, all of La Porte.

CEDAR RAPIDS, IA.—The Central Telephone & Telegraph Company has been incorporated at Cedar Rapids. Capital, $500,000. Incorporators: A. T. Averill, G. M. Averill, E. M. Scott, all of Cedar Rapids.

ALTOONA, PA.—The controlling interest in the Phœnix Telephone Company, of this place, has passed from A. V. Dively and J. D. Hicks to other county stockholders and a new system of cables will be erected in this city.

OCEAN CITY, MD.—A new telephone company has been organized in Worcester County, Md., to build a line from Snow Hill to Berlin, thence to Ocean City. Mr. L. L. Derrickson is president, and O. D. Collins, treasurer.

LA CROSSE, WIS.—At the annual meeting of the La Crosse Telephone Company, the following officers were elected: President, I. H. Moulton; vice-president, W. W. Cargill; secretary and treasurer, William Lohmiller.

TRENTON, N. J.—The Plainfield Telephone Company has been incorporated. Capital, $15,000. Incorporators: A. Dingler, R. J. Emory, both of Jersey City; H. F. Atkinson, of Red Bank; G. H. Atkinson, attorney, Jersey City.

CONRAD, IA.—The Conrad Telephone & Telegraph Company has been organized here. Capital, $5,000. Incorporators: D. Marsh, M. H. McClain, W. H. Stark, E. L. Guild, F. W. Alexander, E. W. Barnes, all of Conrad.

ALBANY, N. Y.—It is reported that the Hudson River Telephohne Company will absorb the Troy Telegraph & Telephone Company. The Hudson River Telephone Company is capitalized at $2,000,000 and the other at $250,000.

CANISTEO, N. Y.—The Greenwood & Canisteo Telephone Company, of Steuben County, has been incorporated. Capital, $3,000. Directors: A. P. Woodward, N. E. Coston, J. M. Atkins, J. S. Tobias, Greenwood; Frank Failing, Rexville.

CHARLESTON, S. C.—The American Bell Telephone Company has been sued by the Charleston (S. C.) Mining & Manufacturing Company for $50,000 alleged damages for entering upon the lands of the former and tramping down the grass.

CHARLESTON, W. VA.—The Petroleum Telephone Company has been chartered. Capital, $1,000,000. Incorporators: J. H. High, C. G. High, G. O. Chilton, J. F. Noyes, F. L. McGee, all of Charleston; J. W. Malcolm, attorney, Charleston.

WORCESTER, MASS.—The Citizens' Telephone & Telegraph Company has been formed by Worcester men, with a capital stock of $300,000. Henry S. Pratt, president of the Ware-Pratt Company, is at the head of the new corporation.

BALTIMORE, MD.—Mayor Hayes is negotiating with the Maryland Telegraph & Telephone Company for the installation of an exchange in the city hall and the replacing of Chesapeake and Potomac telephones now in service throughout the municipality by Maryland telephones.

ST. LOUIS, MO.—The Kinloch Long Distance Telephhone Company, of Missouri, has been incorporated at Jefferson City. This means that the Kinloch Company is to enter the field against the Bell Company in the long-distance service. For the present the competition will be confined to towns in Missouri and Illinois.

MELOTT, IND.—The Melott Telephone Company will put in an exchange in Mellott, Newton, Hillsboro, Stone Bluff, Veedersburg, Attica, Wingate and Waynetown. The capital stock is $3,500 and the directors are Charles Archer, S. A. Moore, H. E. Carpenter, J. W. Royal Mason Simmons, W. F. Mellott and William F. Gerrard.

JERSEY CITY, N. J.—The annual meeting of the stockholders of the Hudson Telephone Company was held recently. The directors elected are: John A. Blair, Edwin Brooke, W. J. Davis, Henry C. Vance, Clement I. Walker, Lewis E. Wood, Edw. W. Jones, James B. Curtis, Philip E. Martin, Arthur W. Deas and A. L. Angle.

WAUSAU, WIS.—The Marathon County Telephone Company has been incorporated, and a meeting will be held in this city July 11 to elect a board of directors and discuss plans. The capital stock is $10,000. It is proposed to begin the work of construction by July 1. In a short time the Little Wolf River Telephone Company's lines will be connected to the system.

ALBANY, N. Y.—The Salamanca Telegraph & Telephone Company, of Salamanca, has been incorporated to operate in Salamanca and through the counties in the western part of the State, with terminus at Bradford, Pa., its circuit to include the cities of Rochester and Buffalo. The capital is $10,000, and the directors include Charles R. Gibson, Edward Bolard, Hudson Ansley and Charles S. Fish, of Salamanca.

INDEPENDENCE, KAN.—A petition for a franchise for the Hickman-Perkins Telephone Company to operate in Kansas City is to be made. The object of asking for the franchise is to give this section of Kansas direct telephone connection with Kansas City. If the franchise is granted, it will connect Kansas City with several points in the Indian Territory, including Bartlesville, as well as Southern Kansas towns.

ELIZABETH, N. J.—The New York & New Jersey Telephone Company offers to pay this city $75 a mile for the use of streets in which to lay a conduit for its wires. The company also agrees to furnish the city with 25 free telephones for its official business, and to give telephone service free to the police department to all points within a radius of 20 miles of Elizabeth. The company asks for the franchise for a term of 50 years.

MASON CITY, IA.—The Central Telephone & Telegraph Company, composed of Cedar Rapids and Mason City capitalists, has completed a deal for the

purchase of the Greene & Western Northwestern, Fitzgerald & Northfield Telephone systems. This gives it about 1000 miles of toll lines in Northern Iowa and Minnesota exchanges in Mason City, Charles City, Osage, Northfield and other towns. A line is being built to Shakope, Minn.

PITTSBURG, PA.—The Central District & Printing Telegraph Company has decided to inaugurate a new idea for the improvement of its service in the down-town portion of the city. A building has been rented on Fifth Avenue, and it will be fitted up as a pay station, with a number of telephone booths for the accommodation of shoppers and down-town visitors in general. Until now the telephone company had only one pay station in the down-town section of the city, except those in the hotels.

NEW YORK, N. Y.—The Knickerbocker Telephone & Telegraph Company is making rapid progress, although its wires are not yet in use. The new company, it is reported, has some 5700 subscribers, and new names are being added at the rate of 40 a day. One hundred and fifty working wires have been laid in the subway from the down-town district to Twenty-third Street, 400 wires from Twenty-third Street to 135th Street, and 20 wires from 135th Street to the city line. The pole line work has just been completed from Long Island City through Jamaica and Flushing to Far Rockaway.

BOSTON, MASS.—The Massachusetts Telephone & Telegraph Company, of Boston, has filed with the commissioner of corporations the following certificate of condition of Nov. 1, 1899:

Assets:		Liabilities:	
Const. and personal prop...	$4,472	Capital stock....	$10,000
Balance profit and loss.....	8,241	Debts....	2,713
Total	$12,713	Total....	$12,713

BOSTON, MASS.—The stockholders of the Erie Telegraph & Telephone Company at their recent annual meeting elected a board of directors, which includes 11 new members who are directors of the Telephone, Telegraph & Cable Company of America. The new members are George Crocker, Frank A. Cutting, Frederick A. Farrar, Harrison W. Gawtry, William H. Gelshenen, William J. Latta, Martin Maloney, Charles W. Morse, Daniel O'Day, Frank Tilford and Henry R. Wilson. The board organized by electing Charles J. Glidden, president; Charles E. Adams, vice-president; George B. Perham, secretary, and Chas. A. Grant, treasurer.

ELECTRIC LIGHT AND POWER.

HAMMOND, IND.—The electric light plant of the village of West Hammond, Ill., was completely destroyed by fire recently. The loss was $6,500.

WINONA, MINN.—It is understood that the Northwestern Railroad officials are planning to put in an electric light plant at the shops in this city.

CITY OF MEXICO, MEX.—A new electric light plant is being installed at Tula de Tamaulipas, Mexico, by Mr. Henry Guerra, a well-known Mexican capitalist.

VENICE, ILL.—The Venice Light & Power Company has received the contract from the Messrs. Freedringhaus to furnish electric light for the Granite City plants.

RALEIGH, N. C.—The Goldsboro Illuminating & Traction Company has been chartered. The capital stock is fixed at $15,000, with privilege of increasing it to $100,000.

FAIRMONT, W. VA.—The plant of the Fairmont Electric Light & Power Company was purchased through S. L. Watson, of this place, by B. K. McMechan, of Wheeling.

WATERLOO, IND.—The Waterloo Electric Light & Power Company has been incorporated. Capital, $5,000. Incorporators: H. K. Leas, J. P. McCayne, M. Kiplinger, A. Kelly, all of Waterloo.

ISLIP, N. Y.—The Sayville Electric Company of Islip, Suffolk County, has been incorporated. Capital, $15,000. Directors: Daniel D. White, J. H. Green, Jr., Francis Gerber, Joseph A. Nauert, Sewell Thornhill, of Sayville.

SHELBY, OHIO.—The village of Shelby, at a recent election, voted $15,000 for improvements and extension of its electric light plant. Potter & Benson, of Chicago, have been retained as engineers.

CENTERVILLE, IA.—The Citizens' Electric Light & Gas Company has been incorporated. Capital, $35,000. Incorporators: D. C. Campbell, T. P. Shouts, J. A. Campbell and C. P. Campbell, all of Centerville.

ROCK HILL, S. C.—The Catawba Power Company, of Rock Hill, S. C., capital stock $100,000 has been chartered. The company will develop electrical power near Rock Hill, as already mentioned in these columns.

CANANDAIGUA, N. Y.—The Ontario Light & Traction Company of Canandaigua has been incorporated. Capital, $100,000. Directors: J. Howard Burgess, Elmira; J. H. Pondee and H. B. Ferguson, Canandaigua.

GREENSBORO, N. C.—The Guilford Power Company, of Greensboro, N. C., has applied to the city for a limited franchise to construct an electric railway over the city. The company is backed by strong capital.

SULLIVAN, IND.—The Sullivan Heat, Light & Power Company has been incorporated. Capital, $25,000. Incorporators: W. N. Crowder, L. A. Stewart, C. H. Crowder, P. L. Reid, E. S. Crowder, all of Sullivan.

KESWICK, CAL.—The Keswick Electric Light Company was incorporated by H. D. Scribner, A. T. Johns, P. S. Coke, H. S. Donnels and W. H. Bone, with a capital stock of $50,000, of which $50 was subscribed.

ST. LOUIS, MO.—It is said that the board of public improvements has been notified verbally that the Missouri-Edison Company or the Laclede Gas Company would not accept a contract on less than 60 days' notice. This would necessitate a notification by July 1, in case of a forfeiture of the Kern contract.

ALBANY, N. Y.—The Ontario Light & Traction Company has been incorporated, with a capital of $100,000. This is a reorganization of the Canandaigua Electric Light & Railroad Company. J. Howard Burgess, Elmira; J. H. Pardee and H. B. Ferguson, of Canandaigua, are directors.

RED BLUFF, CAL.—The Red Bluff Electric Power Company has been incorporated to generate and develop electricity for heat, light, etc. Capital, $250,000. Incorporators: D. S. Cone, C. F. Foster, E. H. Ward, all of Red Bluff; J. D. Sherwood, of Spokane, Wash.; W. N. Woodson, of New York City.

VIRGINIA CITY, NEV.—The Truckee River General Electric Company has awarded the contract for its sub-station building in Virginia City, Nev., to W. A. McIntosh. It will be 25 x 50 ft., and contain six oil-cooled, lowering transformers.

JERSEY CITY, N. J.—The Massachusetts Power Company has been incorporated, with headquarters in this city. Capital, $750,000. Incorporators: R. M. Wiers, R. S. Checkley, K. A. Hammerer; R. M. Wiers & Company, attorneys, New York.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company of this city has filed articles increasing the capital stock of the company from $550,000 to $700,000. This is the second increase of capital made by this concern within a year, the previous increase being $50,000.

PORTLAND, ME.—The Sagadabock Light & Power Company, of Portland, has been incorporated. Capital, $200,000. Incorporators: G. F. West, A. S. Bosworth, H. W. Ricker, all of Portland; S. C. Manley, J. H. Manley, of Augusta; Symonds, Snow & Cook, attorneys, Portland.

LOS ANGELES, CAL.—The Excelsior Power Company, of Los Angeles, has been incorporated. Capital, $150,000. Incorporators: C. A. Hooper, G. W. Hooper, D. C. Henny, all of San Francisco; R. P. Winters, of Riverside; F. L. Morgan, F. B. Crosier, S. Borden, all of Los Angeles.

BALTIMORE, MD.—The directors of the Maryland Penitentiary opened proposals for the installing of an electric plant for the purpose of running the machinery in the shops. The bids were referred to the monthly committee, consisting of the president, Col. Francis E. Watts and Warden Weyler.

TAMPICO, MEXICO.—The new electric light plant at this place is almost completed and ready for operation. It is owned by Borde & Company. It will furnish lights for the city and to private consumers. The Mexican Government is also installing an electric light plant in its new custom house building at Tampico.

CHAMBERSBURG, PA.—To liquidate a floating indebtedness of $12,000 and to secure sufficient money to place the borough electric light plant in good working order, the voters of Chambersburg will pass upon the proposition to issue bonds to the amount of $25,000. The special election for the purpose will be held on July 24.

ST. LOUIS, MO.—James Campbell, who represents the controlling interest in the Laclede Gas Company, is in New York, where he went, it is said, to arrange with Hugh H. Harrison, who represents the controlling interest in the Imperial Electric Light, Heat & Power Company, for a division of territory in the lighting and power field.

PLAINFIELD, N. J.—The Plainfield Gas & Electric Light Company, of Plainfield, N. J., has recorded a mortgage for $500,000, to run 40 years, in favor of the Morton Trust Company, of New York. The mortgage is given to cover the issue of five hundred $1,000-bonds, payable in gold and bearing interest at 5 per cent, payable semi-annually.

OAKLAND, CAL.—The City Council of Oakland, Cal., recently received a bid from the Oakland Gas, Light & Heat Company, making an offer to light the streets and public places. The company offers to allow the city to have 60 additional street lights for the amount paid for the last year's lighting. Under the new arrangement there would be 650 lights.

CINCINNATI, OHIO.—The Cincinnati Gas Light & Coke Company has determined to enlarge its capacity for lighting in order to meet the competition of the Cincinnati Edison Electric Company. The Fort Wayne Electric Works have secured the contract for two 200-kw, alternating-current dynamos. Two Ball (Erie) engines will also be added to the present equipment.

CITY OF MEXICO, MEX.—The city councils of the towns of Tlalpam, Mixcoac, San Angel and Coyoacan, in Mexico, have taken steps looking to the establishment of a joint electric light plant to furnish lights for all of the towns mentioned. These places are located near one another, and it will be possible for one electric light plant to supply all of them with the necessary lights.

MILWAUKEE, WIS.—An electric power plant has just been installed at the F. Mayer Boot & Shoe Company, where gas is used as the motive power. Motors aggregating 136 horse-power are furnished current by a 100-kw generator, which is run by a gas engine. This is the first instance in this city where a gas engine has replaced a steam engine. Formerly the factory was run by a steam engine running shafting.

RICHMOND, IND.—By the recent action of the City Council this city is practically assured of a municipal electric light plant. The light committee reported in favor of the immediate construction of a plant, and the report was approved. The city plant will be devoted to furnishing commercial light until the contract with the Light, Heat & Power Company expires, after which the city lighting will be taken up.

SAN FRANCISCO, CAL.—The Independent Electric Light & Power Company, San Francisco, has most of its machinery in position in the main power station, and the sub-stations are nearly ready for business. The system will probably be in operation early in August, and current will be supplied from the main power station in July for the operation of the San Francisco & San Mateo Electric Railway. A third sub-station for a rotary transformer will be built on the San Mateo line when that road is extended to San Mateo.

BLUE LAKES CITY, CAL.—The plant belonging to the Standard Electric Company, which was destroyed by fire last fall, has been temporarily housed in a wooden building, the exciters and two of the S. K. C. generators having been rewound; it has resumed a portion of its service of light and power to the mines and towers of Amador and Calaveras counties. The new plant, three miles up the Mokelumne River is progressing rapidly, and will be ready for service in a few months. The output of the station is to be 10,000 kilowatts, with a line voltage of 60,000 volts.

FRANKFORT, IND.—William R. Hines and others have filed an injunction

suit against this city to stop the construction of the municipal electric light plant on the ground that the cost of the plant would exceed 2 per cent, the constitutional limit of taxable property. The city has the power house completed, all necessary machinery contracted for, poles erected and wires strung, and everything would have been in readiness for starting the plant July 1. The city authorities believe the attempt will fail, although the courts construe the statute relative to limiting a city's debt very rigidly.

THE ELECTRIC RAILWAY.

PHILADELPHIA, PA.—The receipts of the Union Traction Company on Memorial Day reached $54,000.

LANCASTER, OHIO.—The power house of the Lancaster Traction Company was gutted by fire recently.

TOLEDO, OHIO.—The Toledo Traction Company is preparing to illuminate Superior Street, this city, with arches of 50 lights each.

YANESVILLE, WIS.—Winnebago County, Ill., has voted a 50-year franchise to the Rockford, Beloit & Yanesville Electric Railway Company.

YOUNGSTOWN, OHIO.—The Mahoning Valley Electric Railway Company has secured the right of way for a new line between this city and Warren.

YOUNGSTOWN, OHIO.—The Mahoning Valley Electric Railway has been appraised at $103,930, a net increase of $250 per mile and a net increase of $10,000.

BELOIT, WIS.—Recently a party of 20 Ohio men were here to promote the scheme of an interurban electric railway line between Beloit, Rockford and Yanesville.

WARREN, OHIO.—The local power house of the Mahoning Valley Electric Railway Company has been abandoned and the equipment has been removed to the power house at Niles.

ST. LOUIS, MO.—The St. Louis, St. Charles & Western Railroad Company has been granted an extension of one year in which to comply with the conditions imposed by the County Court.

ASTORIA, ORE.—The Security Savings & Trust Company, of Portland, Ore., recently obtained a decree of foreclosure of mortgage against the Astoria Street Railway Company, Astoria, Ore.

TOLEDO, OHIO.—The Victor Park Railway Company, of Toledo, has been incorporated. Capital, $50,000. Incorporators: C. W. Ryan, J. W. Ryan, J. D. Besly, F. J. Arbuckle, F. W. Caughling.

LISBON, OHIO.—Healy & Hefton, owners of the East Liverpool Street Railway, are projecting a line to connect East Liverpool with Lisbon and Salem. A franchise has been granted them in this place.

LANCASTER, OHIO.—The power house of the Lancaster Traction Company was completely gutted by fire and water recently. All of the electric cars, for both summer and winter use, were greatly damaged.

AKRON, OHIO.—Employees of the Akron & Cuyahoga Falls line of the Northern Ohio Traction Company have been given an advance in wages. They asked for 20 cents an hour and compromised at 17⅔ cents.

COLUMBUS, OHIO.—The Portage Lakes Traction Company, Cleveland, has been incorporated, with $10,000 capital stock, by David M. Glascock, Henry Lancefield, T. S. Dunlap, Carl H. Nau and Charles L. Stocker.

SPARTANSBURG, S. C.—The Spartansburg (S. C.) Railway, Gas & Electric Light Company has so far completed four miles of electric railway. A 250-hp engine has been received. The cars are expected within a week.

CHICAGO, ILL.—Waukegan and Fox Lake are to be connected by an electric line. The Waukegan, Fox Lake & Western Railway Company has been incorporated at Springfield, with a capital of $100,000 for the purpose.

YOUNGSTOWN, OHIO.—The Mahoning Valley Electric Railway Company is planning to build a branch from Youngstown to Newcastle, passing through Lowellville. A 25-year francnise has been asked for in Lowellville.

OMAHA, NEB.—The East Omaha Street Railway property, including rolling stock, tracks, right of way, lands, buildings, franchises, etc., has been transferred to the Omaha, Council Bluffs & Suburban Railway Company.

ST. LOUIS, MO.—The application by the legal representatives of the Fourth Street & Arsenal Railroad for right of way to run its cars over the line of the People's Railway on Fourth Street has been denied by the Circuit Court.

LANSING, MICH.—The contract for building the Lansing, St. Johns & St. Louis Electric Railway was signed by John E. Mills, F. C. Norris and E. F. Percival, of Port Huron. Work begins June 15. The line will cost fully equipped about $1,500,000.

WINSBORO, S. C.—The Winsboro & Camden Railway Company, Thomas K. Elliott, T. H. Ketchin, J. E. McDonald and W. R. Elliott, incorporators, has secured a commission from the State of South Carolina. The capital stock is $300,000. Total length of road, 30 miles.

BROOKLYN, N. Y.—The earnings of the Brooklyn Rapid Transit system Decoration Day were about $47,000 against $46,000 the previous year. During the month of May, Brooklyn Rapid Transit earnings were a little more than $1,000,000 gross, an increase of about $21,000.

OTTAWA, ONT.—The Grand Trunk Railway is equipping its passenger train locomotives with electric lighting apparatus. Each locomotive is provided with a steam engine and dynamo for the generation of the current. All the lights of the locomotive, including the headlight, are electric.

RICHMOND, VA.—The Virginia Conduit Railway Company, of Richmond, has been chartered. Capital, $1,000,000. Incorporators: A. Pizzini, Jr., W. S. Forbes, W. B. Davis, W. R. Johnston, P. Davie, E. A. Horn, J. D. Patton, W. F. Jenkins, all of Richmond; A. B. Guigan, attorney, Richmond.

ASHEVILLE, N. C.—J. E. Rankin, president of the Asheville Street Railway Company, states that a line will be built at once to Biltmore. The Asheville Electric Company already has a circuitous line to Biltmore, and the new competition is already producing considerable discussion between the rival companies.

LITTLE ROCK, ARK.—Hon. James A. Woodson has been elected president and general manager of the Little Rock Traction & Electric Company; Oscar Davis, vice-president, and Charles F. Penzel, treasurer. It is stated that if certain franchises are granted the company will expend between $75,000 and $100,000 in improvements.

ST. LOUIS, MO.—The St. Louis, Clayton & Western Railway Company has been granted an extension of six months in which to comply with the stipulations of its contract. The president of the road says that the unsettled labor conditions have prevented him from making arrangements with the Transit Company to build the line.

PITTSBURG, PA.—President Roach, of the Union Traction and the Consolidated Traction companies, has issued an order to the effect that the money the trainmen had paid out for indemnity bonds would be returned to them and that the order compelling them to go to a tailor designated by the company to buy their uniforms was rescinded.

BEAVER, PA.—Arrangements have been finally effected whereby a majority of the stock of the Beaver Valley Traction Company, of the People's Electric Street Railway, of Rochester; the College & Morado Railway, and the Beaver & Vamport Electric Railway, passed into the hands of some capitalists who will unite all the interests under one management.

FOND DU LAC, WIS.—Articles of incorporation for the Wisconsin Rapid Transit Company were filed on June 6, signed by H. G. Smith, C. D. Smith and R. S. Wilkins. The company's object is to construct an electric line for carrying passengers, mail and express matter, and to construct and operate telegraph and telephone lines. The company is capitalized at $25,000.

NEW HAVEN, CONN.—It is announced that negotiations are about concluded for the purchase of the Enfield and Long Meadow Electric Railway Company by the A. M. Young syndicate of New York. The purchase will make the tenth Connecticut electric road acquired by the Young syndicate. The Enfield road is 10 miles long and is capitalized at $116,000.

COLUMBUS, OHIO.—The city board of public works has requested the director of law to bring suit to test the validity of the franchises of every street railway line owned by the Columbus Railway Company. The city authorities contend that all of the franchises are either invalid by reason of illegal grants or have been forfeited through failure to perform the conditions of the grants.

PITTSBURG, PA.—The employees of the Westinghouse Electric works had their annual picnic last Saturday. The men and their families spent the day at Kennywood Park, and a very enjoyable time was passed in all kinds of games and other amusements. Kennywood Park is the property of the Monongahela Traction Company, and is considered one of the finest resorts about Pittsburg.

SCRANTON, PA.—The Scranton & Northeast Railroad Company has been chartered. The capital stock is $100,000. The incorporators are: T. F. Penman, president; C. C. Mattes, A. P. Bedford, M. E. McDonald, all of this city; Henry C. Riley, Jonathan Jenks, Stanley R. Ketcham, Philadelphia; B. K. Focht, Lewisburg; E. S. McNaul, Lock Haven, and C. B. Boughton, Buffalo, N. Y.

PITTSBURG, PA.—The Monongahela Traction Company has let a contract for the construction of six miles double-track extension of its street car lines, which will form a short and direct route from Pittsburg to McKeesport. The company will spend $400,000 on this work. The plans for this improvement were made by George S. Davidson, general manager of the Monongahela Traction Company.

PHILADELPHIA, PA.—At a meeting of the Park Commission's committee on plans and improvements, it was decided to recommend the acceptance of the Fairmount Park Transportation Company's line as a park fixture, on condition that the road be completed as specified in the lease. Two per cent. of the gross receipts of the road, to which the commission is entitled, will be spent for park improvements.

SACRAMENTO, CAL.—Superintendent F. H. Ross, of the Sacramento Electric, Gas & Railway Company has announced an advance in wages of conductors and motormen on the lines in Sacramento, Cal. The increase amounts to an average of about 10 per cent, and is graduated according to the length of time the men have been in service. The increase was voluntary, there having been no demand made by the employees of the company.

NEW YORK, N. Y.—Trolley cars on the extension of the Port Chester Street Railway are now running between the villages of Rye and Harrison, on Long Island Sound. At Harrison the road connects with the line of the Larchmont Horse Railroad Company, which is now being completed to New Rochelle. The two lines are said to be controlled by the New Haven Railroad Company. The extension of the Tarrytown, White Plains & Mamaroneck Railway to the Larchmont village line is also in operation.

BOSTON, MASS.—The railroad commissioners have refused to grant the petition of the West Somerville Board of Trade for improved train service on the Boston & Maine Railroad between West Somerville and Boston, a distance of four to five miles. The commission in its order says: "The growth in the street railway service in this territory has been such as to very materially reduce the travel upon the steam railroad. It is to be expected that until some new and more effective method of competition is adopted by steam railroads, communities at this distance from Boston will increasingly use the facilities for travel afforded by street railways. Through the extension of the system operated by the Boston Elevated Railway Company the people of West Somerville will soon have better accommodations for travel to and from Boston."

TORONTO, ONT.—A new power plant has been constructed by the Metropolitan Railway Company, of Toronto, Ont. The Westinghouse Electric & Manufacturing Company supplied the electric plant and railway equipment, also motors for freight and passenger rolling stock and an electric locomotive. The company's new power house is at Bond's Lake, 18 miles from Toronto, and is operated by steam power. It is projected to make further extensions to the Metropolitan Company's lines, and one, 13 miles long, is already under construction. The company has now added to its stock a large Baldwin-Westinghouse

electric locomotive, which in future will haul railway cars direct from the lines of the Canadian Pacific Railway to all stations upon the Metropolitan Company's system. By this means the cost of trans-shipment of goods to any point in the United States will be avoided. The locomotive has driving wheels 33 ins. in diameter, and weighs 57,000 lbs. It is equipped with four 50-hp Westinghouse 38-B motors, and is designed to run at a speed upon the level of 35 miles an hour, hauling cars with an aggregate weight of 60 tons.

THE AUTOMOBILE.

THE ELECTRIC VEHICLE COMPANY, of New York, it is reported, is negotiating for the purchase of the New Haven Carriage Company. The latter is owned by the Columbia Automobile Company, of Hartford, having been purchased about a year ago.

AUTOMOBILE FACTORY IN OTTAWA.—Arrangements are on foot for the establishment of an automobile factory in Ottawa. A number of gentlemen from Toronto, Ont., interested in the enterprise, have been in the Canadian capital looking over the ground. The establishment will be the Canadian branch of an American firm engaged in the manufacture of these vehicles.

AUTOMOBILES IN NEWPORT.—As a result of the automobile agitation in Newport, an ordinance has been passed by the City Council providing that in the compact part of the city the speed must not exceed six miles an hour, and outside the city proper 10 miles an hour. The ordinance provides a fine of $20 or 10 days' imprisonment, or both, for a violation of the ordinance. It covers all kinds of automobiles, bicycles, or any vehicle the propelling power of which is within itself.

NEW INDUSTRIAL COMPANIES.

THE INDIAN TERRITORY COMPANY has been incorporated at Dover, Del., to construct railroad, telegraph and telephone lines and to do a general mining and manufacturing business. Capital stock, $5,000,000.

THE MILLER-KNOBLOCK ELECTRIC MANUFACTURING COMPANY, of South Bend, Ind., to manufacture electrical machinery. Capital, $125,000. Incorporators: J. C. Knoblock, O. M. Knoblock, H. G. Miller, all of South Bend.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, of Providence, R. I., to manufacture and sell automatic switchboards. Capital, $1,000,000. Incorporators: E. M. Prindle, J. W. Phillips, F. W. Reed, S. W. Tabor, F. A. Seib, all of Providence, R. I.; Tillinghast & Tillinghast, attorneys, Providence, R. I.

THE CORPORATE INVESTMENT COMPANY has been incorporated at Trenton, to manufacture and deal in all kinds of power and lighting, to build reservoirs and electrical apparatus and operate railroads and canals. The capital stock is fixed at $2,000,000. Among the incorporators are George Walbridge, S. Kingsbury Curtis, H. S. Collette, R. B. Marchant, George X. McLaughan and Charles L. Bartow, all of New York.

LEGAL.

RIGHTS OF CORPORATIONS IN NORTH CAROLINA.—The North Carolina Supreme Court, in the case of a private individual against the Bell Telephone Company, has decided as constitutional the "Craig Law," providing for the domestication of foreign corporations, and providing further, that a corporation so domesticated has not the right of the removal of the case to the Federal courts.

BULLOCK "TEASER" PATENTS.—We are informed that a decree has been entered in the cases of the Bullock Electric Manufacturing Company vs. Baltimore *Evening News*, and Bullock Electric Manufacturing Company vs. George Knapp & Company, publishers of the St. Louis *Republic*, sustaining the validity of the "Teaser" patents, finding an infringement by the defendants and ordering an injunction. The "Teaser" patents cover a system for operating large newspaper presses and other machinery by electricity. This decision it is claimed, gives the Bullock Company the exclusive right to manufacture this apparatus.

PERSONAL.

MR. P. McCULLOUGH, electrician of the Toronto Street Railway, will leave that city on June 24, to take charge of the electrical department of the Corporation Tramways of Liverpool, England.

PROF. R. B. OWENS has received from Columbia University the Tyndall scholarship for the coming year. This will be the third year that Prof. Owens will have held this much-coveted scholarship.

MR. MORRIS MOSKOWITZ, the inventor of a system of lighting trains electrically by utilizing the power generated at the axle, which system is now in use upon a number of the American railroads, and is controlled by the Consolidated Railway Electric Lighting & Equipment Company, has been awarded the John Scott medal by the city of Philadelphia on the recommendation of the Franklin Institute of that city.

Trade Notes.

THE MILWAUKEE ELECTRIC COMPANY, 296 Reed Street, Milwaukee, Wis., has opened a branch office at 1210 Chemical Building, St. Louis, Mo.

THE GREGORY ELECTRIC COMPANY, 54 Clinton Street, Chicago, Ill., has just received 50,000 lights capacity of transformers, which are now being tested in its works, and when ready for the market will be guaranteed perfect and equal to new.

BIDS OPENED.—Bert Baldwin, mechanical engineer, Cincinnati, Ohio, is opening bids for direct-connected electric generators for the Crane-Hawley Company's plant in that city. A 50-kw generator will be installed.

THE MILWAUKEE ELECTRIC COMPANY, Milwaukee, Wis., has secured many good orders lately. Several large size machines are called for among the orders. The company has been operating its shops day and night for some time.

THE INDIANAPOLIS ARM, BRACKET & PIN COMPANY has succeeded J. B. Magers, Jamestown, Ind. The company manufactures pins and brackets for telephone and telegraph work. Its address is 125 South Meridian Street, Indianapolis.

THE STANDARD TOOL COMPANY, Cleveland, Ohio, has recently issued a very neat catalogue of 24 pages, in three languages, illustrating and pointing out the features of its line of twisted drills. The three languages are English, French and German.

STEAM SPECIALTIES.—The Creamer Perfection Steam Specialties Company, of 133 Liberty Street, New York, has issued a new catalogue of its various steam specialties. Among these are pump governors, steam traps, boiler feeders and balance valves.

MINING LOCOMOTIVES.—The Westinghouse Electric & Manufacturing Company has closed a contract with the Gould & Curry Mining Company to install a system of electric motors in the new mining works on the Comstock Lode. Several other mining companies are expected to close similar contracts very soon.

MILWAUKEE AUTOMATIC FIRE SERVICE COMPANY, Milwaukee, Wis., lately made several fine improvements on its system. A connection to the sprinkler system in an establishment, so that the operation of the sprinkler is reported, is one of the improvements. The company is increasing its field of business considerably.

THE BULLOCK MANUFACTURING COMPANY, Norwood, Ohio, was compelled to temporarily shut down its works last week on account of the break of a valve controlling the water supply of the town. The suspension lasted for several days, and it came at an unfortunate time for the Bullock Company, as it is rushed with orders.

NASHVILLE, IND.—Brown County, the only county in the State without a railroad, is to be connected with the outside world by telephone. A company has been organized to construct a line from Nashville, via Georgetown and Spearsville, to Nineveh, connecting with Edinburg, Franklin and Indianapolis. Work has begun, and the line is to be completed in 60 days.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, as the outcome of a lawsuit, has passed into the hands of a receiver, as the judge held that elections made Jan. 2 were invalid, and ordered a new election to take place Aug. 30. Mr. R. T. Stillwell has been appointed receiver to take charge of the business pending this new election. The business of the company will proceed as usual.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, will be glad to send copies of its new circular of voltmeters, ammeters, wattmeters, ground detectors and other measuring instruments to any one interested. The book is more pretentious than this company's former price lists as an attempt has been made to include the descriptions and prices of all its regular instruments under one cover.

MR. WILLIAM E. SAUNDERS and Mr. Robert N. Pollack, of the U. S. Carbon Company, were in New York last week upon a business trip. The U. S. Company is enlarging its plant at Cleveland to about four times its present capacity, the business in sight justifying at least this extension, and it is expected that a still further enlargement will be necessary when the new U. S. enclosed arc carbon has been upon the market long enough to demonstrate its merits.

THE LINK BELT ENGINEERING COMPANY, Nicetown, Philadelphia, manufacturers of Link belt elevators and conveying machinery, reports an unusually active condition of business, with no present outlook of slacking orders. It has twice been compelled to increase its capacity during the past few months, and is at present building a large extension to its workrooms, and also the draughting department. New machinery of the most modern types has been installed to facilitate the more rapid filling of orders, and a number of additional workmen employed.

ELECTRIC CONTROLLERS AND CRANE FITTINGS.—These devices are the subjects of an artistic pamphlet recently issued by the Electric Controller & Supply Company, Cleveland, Ohio, manufacturers of the same. They include controllers, lifting magnets, stop brakes, solenoid magnets, switchboards, fuse blocks, trolleys, wire stretchers, wire ears, etc. The various devices are clearly illustrated. The Dinkey controller is designed for controlling by hand operation, direction and speed of electric motors. Several advantageous features are claimed for this device. The cover of the catalogue is of very artistic design.

"THE LIGHT OF EXPERIENCE."—The Manhattan General Construction Company, Newark, N. J., recently issued bulletin No. 114 B, descriptive of the Manhattan series alternating enclosed arc system. It contains an illustration of the Manhattan series alternating-current regulator No. 100, and three styles of lamps. Another illustration shows the mechanism of the series alternating-current lamp. The bulletin also contains diagrams of the wiring of the system, and the last page contains a very handsome illustration of the Manhattan lamp on a shepherd's crook pole.

THE N. P. BOWSHER COMPANY, South Bend, Ind., reports an unusually large sale of its balancing ways during the past few months, due to the unusual activity in all lines of work. Among recent sales reported are some to the following-named concerns: The E. A. Kinsey Company, Cincinnati, Ohio; Public Printer, Washington, D. C.; Massachusetts Electric Company, Boston, Mass.; Upson Coal & Mining Company, Shawnee, Ohio; Jos. Adamson & Company, Cheshire, England; Chas. A. Besly & Company, Chicago; Crompton & Company, Limited, Chelmsford, England; Graniteville Manufacturing Company, Graniteville, S. C.; Georgia Iron Works, Augusta, Ga.; E. G. Bernard Company, Troy, N. Y.; Milwaukee Electric Company, Milwaukee, Wis.; Edison Illuminating Company, Monmouth, Ill.; Schuchardt & Schutte, New York City; Adolphe Janssens, Paris, France; American Tool Works Company, Cincinnati, Ohio; Garvin Machine Company, New York City; S. Bent & Bros., South Gardiner, Mass.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JUNE 12, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

651,343. ELECTRIC RAILWAY; T. P. Chandler, Philadelphia, Pa. App. filed March 10, 1900. This invention is a method of supporting positive and negative conductors one above the other and considerably separated, and consists in making the upper conductor heavy and supporting the under conductor from it by flexible connectors.

651,350. ELECTRIC RAILWAY; W. Grunow, Jr., Bridgeport, Conn. App. filed Feb. 17, 1899. The principal feature of this invention is the provision of means for changing the polarity of the leads connecting with the motor and with a battery on the car, when the independent contacts on the plough are reversed with respect to the working conductors by the turning of the car on a turn-table.

651,361. ELECTRIC TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed May 20, 1899. A system of space telegraphy having part of the generating devices at or near the ground, and another part at a point further removed from the terrestrial influence.

651,362. SPACE TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed May 20, 1899. The transmitting mechanism for space telegraphy is applied to a buoy, so that approaching ships may be warned of the proximity of the buoy.

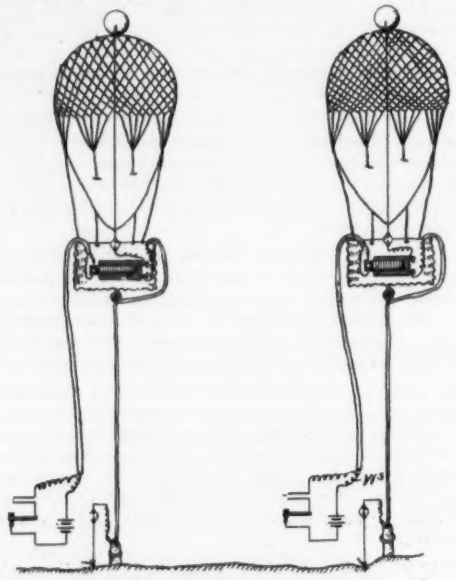
651,363. METHOD OF TRANSMITTING ELECTRIC IMPULSES; I. Kitsee, Philadelphia, Pa. App. filed May 20, 1899. The method of transmitting messages with the aid of currents of high intensity, which consists in opening the shunt of a secondary of an inductorium forming part of the transmitting circuit in accordance with the signs or signals to be transmitted.

651,396. PRODUCTION OF CHROMIUM OXID; E. A. G. Street, Paris, France. App. filed July 8, 1899. (See Current News and Notes.)

651,401. TROLLEY; J. H. Walker, Lexington, Ky. App. filed July 28, 1899. Details of construction, whereby a coating of ice cannot interfere with the operation of the wheel.

651,471. ELECTRODE FOR SECONDARY BATTERIES; P. F. Ribbe, Charlottenberg, Germany. App. filed Feb. 28, 1899. Structural details.

651,472. ELECTRICAL APPLIANCE FOR THE CURE OF DEAFNESS; W. J. Tindall, New York, N. Y. App. filed Feb. 8, 1899. The device is a plug carrying an anode and a cathode so arranged that when the device is coated with an exciting agent, galvanic action will take place. The plug is intended to be inserted into the ear.



651,361.—Electric Telegraphy.

651,473. ELECTRIC LIGHT DIMMER; F. E. Woodford, Appleton, Wis. App. filed Sept. 26, 1898. The lamp and resistance are mounted on the same support and movable together; fixed contacts are arranged, so that when the lamp is raised or lowered, the light is correspondingly raised or lowered.

651,476. SECONDARY OR STORAGE BATTERY; O. T. Bugg, Jr., New York, N. Y. App. filed July 11, 1899. One of the electrodes is the containing cell, while the other is in a bag contained therein, and it is suitably insulated therefrom. The upper part of the cell is provided with sealed chambers, preventing the escape of liquid.

651,483. PIPE OR CONDUIT FOR ELECTRICAL CONDUCTORS; E. T. Greenfield, New York, N. Y. App. filed Dec. 18, 1899. The flexible metallic covering is provided with corrugations forming a screw-thread.

651,484. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; E. T. Greenfield, New York, N. Y. App. filed Feb. 8, 1900. The ends of the cables leading into the box are held in place by a small binding wire, which passes around the cable and around a lug attached to the box adjacent to the opening through which the cable enters.

651,498. ELECTRIC ARC LAMP; E. Bonhivers, Levalloir-Perret, France. App. filed Jan. 2, 1900. (See Current News and Notes.)

651,524. ELECTRIC RAILWAY; A. Casazza, Hoboken, N. J. App. filed June 10, 1899. Details of the switch mechanism controlling the circuit to the working conductor sections.

651,540. AUTOMATIC TELEPHONE SWITCH; R. T. Watt, Laurel Springs, N. J. App. filed April 12, 1900. Details of construction.

651,561. SWITCH FOR OVERHEAD TROLLEY TRACKS; P. F. Werner, Springfield, Mass. App. filed April 12, 1900. A track switch comprising one switch member adapted to be swung vertically into and out of operative position; a second switch member adapted to be swung horizontally into and out of operative position, and means on one of said members adapted to engage the other of said members, whereby the movement of one will effect the movement of the other.

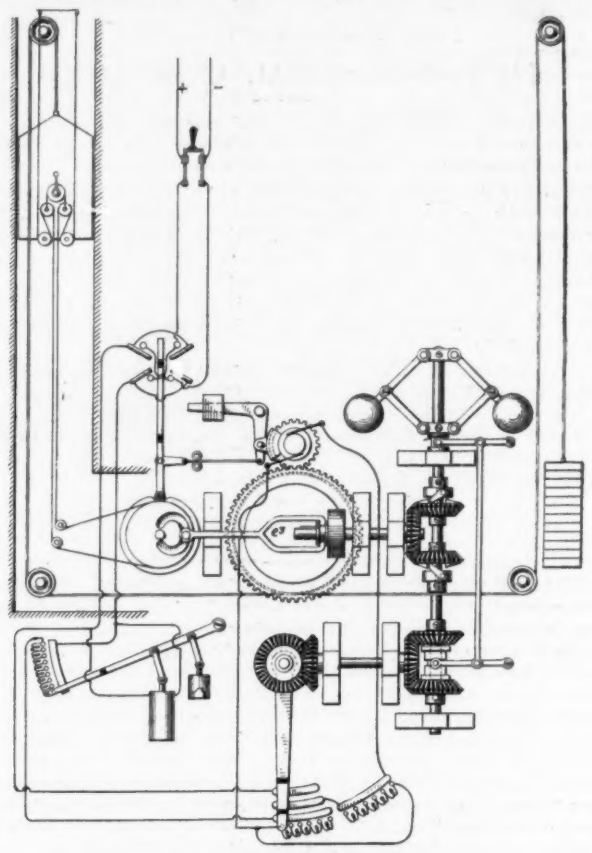
651,575. TROLLEY; F. A. Merritt, Johnstown, Pa. App. filed Sept. 14, 1899. A special construction of the base of the trolley affording a low base and a novel arrangement of the spring.

651,595. ELECTRIC SWITCH; W. Ely, Providence, R. I. App. filed Feb. 5, 1898. Structural details. The object of this invention is to combine with the drum or switch which controls the electric brake, a brake staff and connection to the brakebeam, together with means whereby the latter is not effectively operated until after the final position of the switch is reached.

651,597. ELECTRIC WELDING; R. Eyre, Johnstown, Pa. App. filed Aug. 11, 1898. (See Current News and Notes.)

651,664. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed April 9, 1900. (See Current News and Notes.)

651,672. ELECTRIC ELEVATOR; A. B. See, New York, N. Y. App. filed Nov. 3, 1899. The gearing between the actuating machine of the elevator and a centrifugal governor can be altered by the attendant in the car so as to vary the speed of the governor. The governor thereupon operates a controller of the actuating machine and brings its speed to a point where the governor will stop the movement of the controller. Thus, the speed of the actuating machine can be controlled at will by the car attendant.



651,672.—Electric Elevator.

651,674. AUTOMATIC CAB SIGNAL; H. Stadelmann, Jr., Apolda, Germany. App. filed Oct. 5, 1899. Details of a device for operating an indicator in an engine cab to show how the signals are set against the train.

651,680. ELECTRIC BATTERY ATTACHMENT; H. B. Ware and C. C. Cornell, Wymore, Neb. App. filed Nov. 23, 1899. A tray is suspended under the zinc element in a gravity battery to catch particles that may fall.

651,695. CONTACT FOR INCANDESCENT LAMP BASES; W. C. Bryant, Bridgeport, Conn. App. filed Dec. 30, 1898. The centre contact of the lamp is provided with an outwardly and backwardly extending flange resting against the insulating disc.

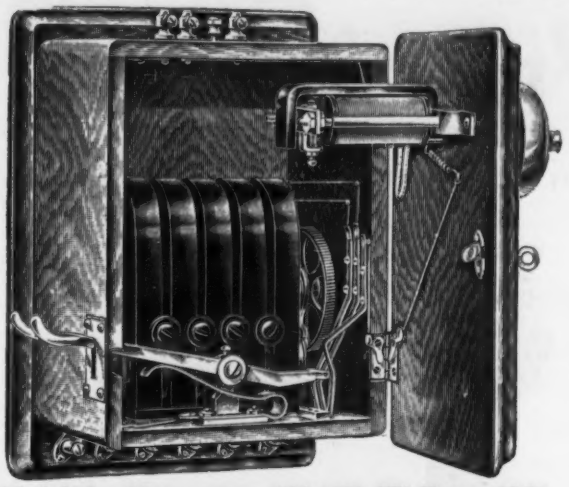
651,697. ELECTRIC CURRENT SHUNTING DEVICE; E. R. Cliff, New York. App. filed Jan. 4, 1900. This device is adapted to hold a coiled-up strip of paper, which may be reeled off at will, and carries certain contacts or circuit-terminals which co-operate with the paper to produce what is known as the paper cut-out, in which the paper is punctured by the discharge across the contacts when the tension of the current rises above the normal.

651,718. METHOD OF ELECTRICALLY TREATING ARCS OF NICKEL; H. Leleux, Paris, France. App. filed June 12, 1899. (See Current News.)

651,733. ELECTRIC ARC LAMP; W. F. Wegner, West Superior, Wis. App. filed March 12, 1900. Details.

651,747. ELECTRO-THERAPEUTIC APPARATUS; F. H. Brown, Chicago, Ill. App. filed Nov. 19, 1898. Musical rheotomes are placed in circuit in an apparatus for administering the current to the human body, and so arranged that current vibrations will pass through the body in musical rythm.

651,771. ELECTRICAL MEASURING INSTRUMENT; E. C. Rimington, London, England, App. filed Jan. 27, 1900. (See Current News and Notes.)



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Easily made and positively retained.

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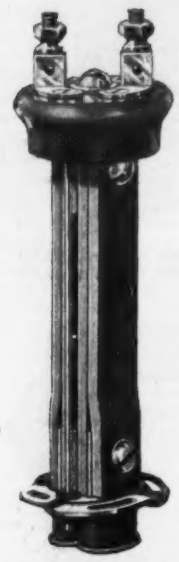

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